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TF 2417 & TF 2418 Series

COUNTER TIMER

INSTRUCTION MANUAL

MP MASTER

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MARCONI INSTRUMENTS

INSTRUCTION MANUAL
No. EB2417 & EB2418
for

COUNTER TIMER
TF 2417 & TF 2418
Series

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

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Chapter 1

General information

1.1 INTRODUCTION

The TF 2417 and TF 2418 Counter/Timers are fundamentally similar instruments, the main differences between them being in their display resolutions and maximum rate of counting.

Both models carry facilities for the measurement of FREQUENCY and FREQUENCY RATIO, PERIOD (by single or multi-period sampling) and TIMING. The TF 2417 carries an additional facility: a general purpose COUNT function.

Results are displayed by side-view numerical indicator tubes, with integral decimal point automatically positioned by the control settings. The display time is adjustable, and facilities for display storage are incorporated.

The accuracy of all time dependent measurements is determined by the reference oscillator: the internal crystal controlled oscillator, or an external frequency source for which an input socket is carried on the rear panel.

A variable trigger level control, with low-pass filter, is provided at the main signal input. On both models the trigger slope for this input is positive.

The main instrument-functions are selected by means of push-buttons, but the COUNT function of the TF 2417 is selected at the range switch.

For the TIME function of both models and the COUNT function of the TF 2417, the gating circuit is operated either by actuation of 'start' and 'stop' push-buttons, or by signals applied to rear-panel-mounted sockets.

A 'test frequency output', carried on the front panel, facilitates the checking of the basic instrument-operations.

Data output, in either serial or parallel form, is an optional feature. When this feature is incorporated the data output lines are available at a rear mounted multi-way socket.

Throughout both models extensive use is made of integrated circuits: TTL for gating, and MOS-LSI for general counting and frequency dividing.

Either model can be inclined at a convenient reading angle by means of a folding stand attached to the ventilated cover. The four instrument-rests provide for stowage of the supply cable.

1.2 DATA SUMMARY

Basic Functions	Frequency measurement Multi-period measurement Timing - two line Count (TF 2417 only)

1.2.1 Functional Characteristics

FREQUENCY (Input A)	
Maximum frequency	TF 2417 - 32MHz TF 2418 - 15MHz
Gating time	Selectable in decade steps: TF 2417 - 1μs to 10 seconds TF 2418 10μs to 10 seconds
Accuracy	±1 count ± crystal stability

MULTI-PERIOD (Input A)	
Maximum frequency	1MHz
Gating time	Selectable in decade steps: TF 2417 - 1 to 10^7 periods TF 2418 - 1 to 10^6 periods
Units of measurement	TF 2417 - 1μs TF 2418 - 10μs
Accuracy	TF 2417 - ±1μs ± crystal stability ± input circuit jitter TF 2418 - ±10μs ± crystal stability ± input circuit jitter Input circuit jitter 0.3%
TIMING	
Time units	TF 2417 - 1μs to 10 seconds TF 2418 - 10μs to 10 seconds
Control inputs	Two line: start input B stop input C or manual push button
Accuracy	TF 2417 - 1μs $^{+0}_{-1}$ time unit * TF 2418 - 10μs $^{+0}_{-1}$ time unit * * ± crystal stability
COUNT (TF 2417 only)	
Input	A
Maximum frequency	32MHz
Control inputs	Two line: start input B stop input C or manual push button

1.2.2 Input Characteristics

INPUT A	
Frequency range	TF 2417 : 10Hz to 32MHz sinewave DC to 32MHz pulse TF 2418 : 10Hz to 15MHz sinewave DC to 15MHz pulse
Sensitivity	10mV range : 10mV rms sinewave 15mV peak pulse 250mV range: 250mV rms sinewave 350mV peak pulse Note - at maximum trigger level the input sensitivity will be degraded. (approximately 3:1 for a sinewave input)
Maximum input	250 V rms
Maximum d.c. level	400 V
Input impedance	1 MΩ 30pF (approx.)
Input coupling	A.C.
Trigger slope	Positive
Trigger level	Adjustable ±50mV on 10mV range ±1V on 250mV range
Frequency response	With the LF position of the trigger level control selected sensitivity deteriorates above 10kHz at approximately 6dB/octave
Paired-pulse resolution	Typically better than 200ns (with pulse width 100ns and inter-pulse spacing 100ns)
Controls	Trigger level/response; two position sensitivity selector

INPUT B and C	
Trigger signal	Negative-going 3V edge
Maximum fall-time	5μs for 3V change
Maximum Input	50 V peak
Input coupling	A.C.
Input impedance	2KΩ (approximately)
Controls	Start-B and Stop-C push button (in addition to coaxial B and C sockets)
EXTERNAL REFERENCE INPUT	
Frequency range	100Hz to 1MHz (sinewave at rated sensitivity)
Sensitivity	500mV rms sinewave 1 V peak pulse
Maximum input	100 V peak
Maximum d.c. level	250 V
Input impedance	20Ω 60pF (approximately)
Input coupling	A.C.
Trigger slope	Negative

1.2.3 Internal Reference Characteristics

TF 2417	10MHz crystal controlled oscillator (output frequency-divided to 1MHz)
Aging rate	$\pm 1 \times 10^{-7}$ per month
Temperature coefficient at 25°C	$\pm 3 \times 10^{-7}$ per °C
Maximum drift (-10°C to +55°C)	$\pm 5 \times 10^{-6}$ (typically)
TF 2418	100kHz crystal controlled oscillator
Stability (+15°C to 30°C)	$\pm 5 \times 10^{-6}$ (better than $\pm 5 \times 10^{-5}$ from -10°C to +55°C)

1.2.4 Display Characteristics

DISPLAY	Side-view numeral indicator tubes; integral decimal point automatically positioned by the control settings. Units of measurement indicated by range switch setting. Gating indicator neon-lamp provided on front panel
TF 2417	6 digit
TF 2418	5 digit
DISPLAY STORAGE	Selectable at STORE push button
OUT push button	Storage facility unused; display time as above
IN push button	Readout retained until end of new sampling period
DISPLAY TIME	
Adjustable	0.1 to 5 seconds or infinite

1.2.5 Outputs

TEST OUTPUTS

Internal standard	TF 2417 1MHz, squarewave TF 2418 100kHz, squarewave
External standard	As external reference input frequency - squarewave
Amplitude	2.5 V p-p minimum
Output impedance	1 KΩ

DATA OUTPUTS

TF 2417/3 and TF 2418/3	Serial output 4 wire b.c.d. 1-2-4-8 code ('1' ≥ + 3.5 V ; '0' ≤ + 0.5 V) 1-wire sequence start signal (positive 12 V pulse) 1-wire clock signal (Negative 12 V pulse) 1-wire print command (Negative 3.5 V edge)
TF 2417/4 and TF 2418/4	Parallel output 4-wire per digit b.c.d. 1-2-4-8 code ('1' ≥ + 2.5 V ; '0' ≤ + 0.5 V) 1-wire print command (Negative 3.5 V edge)

1.2.6 General

POWER SUPPLY	100 - 125 V/200 - 250 V 45-60Hz/400Hz 20W

DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
89 mm	216mm	310mm	2.5kg
(3.5in)	(8.5in)	(12in)	(5.5lb)

1.3 ACCESSORIES

Supplied	Instruction Manual
Optional	Rack Mounting kit Type 54127-111

ALTERNATIVE MODELS

TF 2416 Series	50mHz 7 digit with alternative Internal Reference Oscillators
TF 2423	500mHz Divider

Chapter 2

Operation

2.1 INTRODUCTION

In order that the TF 2417 and TF 2418 Counter/Timers may be used most effectively, the operation and capabilities of the instruments must be known. This chapter outlines installation, power supplies, control location and a brief explanation of the control functions.

2.2 INSTALLATION

The TF 2417 and TF 2418 can be used as rack mounted instruments (using Rack Mounting Kit Type 54127-111) or as bench mounted instruments as supplied. Normally set on the four plastic feet, the instruments can also be used in the tilted position by swinging the carrying handle forward and downwards, applying a slight outward pressure to the handle sides, thus providing an additional front support.

2.3 POWER SUPPLIES

Before connecting a mains supply to the instrument check that the two primary windings of the internal transformer are appropriately connected for the supply voltage and that the correct rated fuse is fitted.

2.3.1 Mains Voltage Setting

To adjust setting, proceed as follows -

(i) Remove the top section of the instrument case by releasing the two securing screws on the sides.

(ii) Locate the row of six base-board mounted terminal pins situated below the POWER switch push-rod adjacent to the transformer.

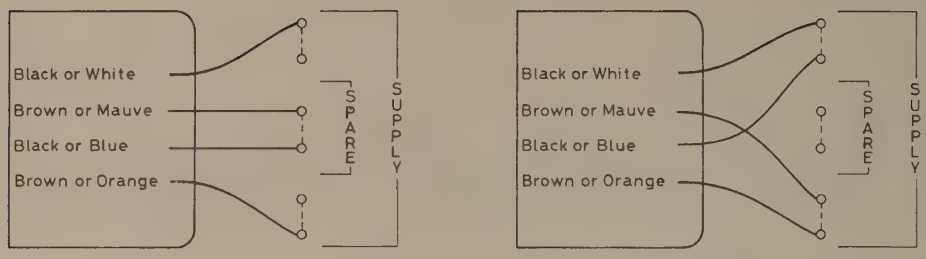
(iii) The primary windings are selected by the appropriate positioning of the flying leads and miniature sockets. Socket to pin connections for 100 - 125V and 200 - 250V AC supplies are shown in Fig. 2.1.

NOTE Pins are represented thus: o.

Chain lines indicate printed circuit copper links beneath the base-board.

The flying sockets of the primary windings are accessible from the top of the instrument; their connections to the base-board-mounted pins may be changed by use of a pair of thin pliers or similar tool. If greater access is required, remove the rear panel fixing screws (one near each corner of the panel) unplug the entire rear panel assembly (complete with its surround) from the rear of the instrument and withdraw the POWER switch push-rod from its two supporting brackets.

When refitting the rear panel assembly, ensure that the rear-mounted power switch engages with the drilled-end of its push-rod. Refit the instrument cover.



Windings series connected (200–250V AC) Windings parallel connected (100–125V AC)

Fig. 2.1 Mains transformer primary winding connections

2.3.2 Mains Fuse Rating

The mains fuse is mounted above the cable entry at the rear of the instrument, check that it is suitable for the supply voltage as follows -

Supply Voltage	Fuse Rating	Marconi Part No.
100 - 125V a.c.	600mA slow blow	TF2417/FPP/23402
200 - 250V a.c.	300mA slow blow	TF2417/FPP/23401

2.3.3 Mains Lead Connection

A suitable mains supply plug must be fitted to the mains lead attached to the instrument. The three conductors are colour coded according to the International standards as follows -

Brown	-	LIVE
Blue	-	NEUTRAL
Green/Yellow	-	EARTH

2.4 CONTROLS AND CONNECTIONS

FRONT PANEL

(1) POWER supply switch. Push button action. The indicator tubes will illuminate when the supply is on.

(2) READOUT. TF 2417 six digit display. TF 2418 five digit display. Decimal point automatically positioned by Range switch.

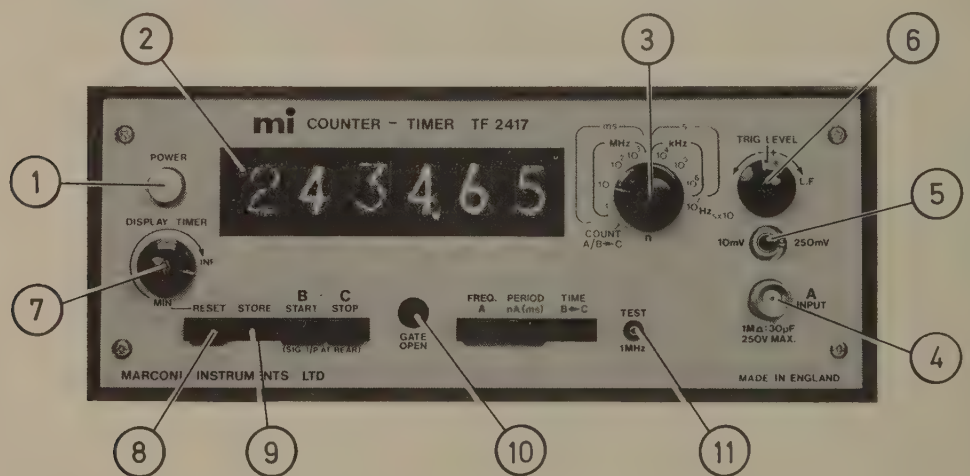


Fig 2.2 Front Panel Controls and Connections

(3) RANGE switch. Selects appropriate range. On TF 2417 extreme counter clockwise position will select the COUNT A/B → C function.

(4) (5) A INPUT, SENSITIVITY switch and TRIGGER LEVEL control. These controls apply only to signals received at the A INPUT socket.

(6) The SENSITIVITY switch (two-position toggle) may be set to 10mV or 250mV. When the amplitude of the input signals is sufficient to permit the use of either sensitivity setting, it is generally advisable to select the '250mV' position to minimise the probability of response to spurious low amplitude pulses that may occur in the input waveform.

The trigger slope for the A-input is positive. The TRIGGER LEVEL control enables the operator to select where the trigger level will lie: in the negative region of the waveform ('-' sector of control), at the zero or transitional point (control top-centre), or in the positive region of the waveform ('+' sector of control).

Trigger Level LF Position:

As the TRIGGER LEVEL control is turned counter-clockwise a ganged - switch is operated to bring into circuit a low pass filter. This setting, which corresponds to the adjacent panel-legend 'L.F.', is intended for low frequency inputs (up to approx. 10kHz) whose waveforms are subject to aberration (caused by h.f. content).

(7) DISPLAY TIMER control. The setting of this control determines the time for which each result is displayed.

If the control is turned counter-clockwise a ganged switch is operated. The control will indicate the panel legend INF (Infinite). The display is retained until the RESET push button is operated.

NOTE A display dimming circuit is operated if more than one of the function push-buttons FREQ., PERIOD, or TIME are depressed. Results shown by a dim display are invalid, for the condition indicates an incorrect setting of the controls.

(8) RESET push button. Momentary depression of this control resets the instrument in readiness for a measurement.

If the STORE push-button is depressed when the RESET push-button is operated only the gating circuit and internal counters will be reset; the display will not change until a new measurement is shown at the end of the next gating period.

(9) STORE push button. This push-button is automatically locked upon depression, and may be subsequently released by applying light momentary pressure.

When the STORE push-button is in the released position (out) the indicator tubes display the progression and result of each count.

When the control is locked in the depressed position each count is displayed until the end of the next gating period, whereupon the new count is shown. On this setting, no visible change will occur in the display if the new count is the same as the previous result.

If count-overflow occurs when the push-button is 'out' the indicator on the extreme left may be seen to reset from 9 to 0, but when the store facility is used no such evidence of overflow is available for only the final result, which is held by the internal counters, is made visible. It is, therefore, advisable to determine the magnitude of a measurement before making use of the store facility.

(10) GATE OPEN Lamp. This neon lamp is illuminated for the duration of the gating period.

When the store facility is in use and consecutive measurements yield the same result, no change will occur in the display; however, the lamp serves to indicate that gating action is occurring and, therefore, that the prolonged display may be accepted as a current result.

NOTE The lamp action will become less noticeable as very short gating times are selected.

(11) 1MHz and 100kHz TEST sockets. The test output is available on all functions. The output is derived from the reference frequency source: the 100kHz directly with the TF 2418 and the 1MHz by way of a decade frequency divider for the TF 2417.

NOTE With the rear panel STANDARD switch in the EXT position the TEST output frequency will be the same as the EXTERNAL source.

REAR PANEL

START B, STOP C input BNC socket.
For external control of count and period measurement.

EXTERNAL Reference frequency input socket.
In circuit only with STD switch to EXT position.

INT/EXT frequency STANDARD switch.

DATA OUTPUT (TF2417/3, TF2417/4, TF2418/3 and TF2418/4)

Data output is presented at the Amphenol 36 pin socket mounted on the bottom right side of the rear panel. Each digit is presented in b.c.d 1-2-4-8 code (for signal specification refer to Chapter 2.13).

2.5 TEST FACILITY

The front-panel-mounted TEST output (TF 2418 - 100kHz, TF 2417 - 1MHz) is available on all functions. The output is derived from the reference frequency source: the '100kHz' directly, and the '1MHz' by way of a decade frequency divider.

The test output may be used to check the counting and readout operations of the instrument. To conduct the test proceed as follows.

NOTE Use coaxial cable for connection to the TEST socket.

(1) Establish the following control settings.

STD switch	:	INT
A-Input switch	:	250mV
TRIG LEVEL	:	Mid-scale
DISPLAY TIMER	:	Mid-scale

(2) Connect the test output to the A-INPUT socket.

(3) Depress the FREQ push-button (the control should lock in the depressed position). Take a measurement on each position of the rotary range switch (for TF 2417 omit the COUNT setting) and compare each result with the corresponding displays given under the appropriate heading in Table 1.

(4) Repeat procedure (3) but for FREQ read PERIOD.

(5) i. Disconnect the TEST output from the A-INPUT socket.

ii. Depress the TIME push-button (it should lock in the depressed position).

iii. Set the DISPLAY TIMER to INF.

iv. Set the range switch to the position marked 1.

v. Momentarily depress the RESET push-button. Momentarily depress the START-B push-button to initiate time-unit counting.

Observe the most significant digit indicator; this should count repeatedly from 0 to 9, changing its display at the rate of one digit per 0.1 second.

Momentarily depress the STOP-C push-button; counting should cease.

vi. Repeat procedure (v) for subsequent settings of the range switch made progressively in the clockwise direction, but note that the counting rate of one digit per second should effectively move one place to the right for each new setting.

(6) TF 2417 (Count)

i. Connect the TEST output to the A-INPUT socket.

ii. Set the range switch to COUNT.

iii. With the TIME and/or PERIOD push-button locked in the depressed position and the DISPLAY TIMER set to INF. momentarily depress the RESET push-button.

iv. Momentarily depress the START-B push-button for counting to commence. Observe the most significant digit indicator; this should count repeatedly from 0 to 9, changing its display at the rate of one digit per second. Momentarily depress the STOP-C push-button: counting should cease.

TF 2417		
RANGE SWITCH SETTINGS	DISPLAYS	
	FREQ.	PERIOD
1	0 0 0 0 0 1 ±1	0 0 0 . 0 0 1 ±1
10	0 0 0 0 1 . 0 ±1	0 0 0 . 0 1 0 ±1
10^2	0 0 0 1 . 0 0 ±1	0 0 0 . 1 0 0 ±1
10^3	0 0 1 . 0 0 0 ±1	0 0 1 . 0 0 0 ±1
10^4	0 1 0 0 0 . 0 ±1	0 1 0 . 0 0 0 ±1
10^5	1 0 0 0 . 0 0 ±1	1 0 0 . 0 0 0 ±1
10^6	0 0 0 . 0 0 0 ±1	0 0 0 . 0 0 0 ±1
10^7	0 0 0 0 0 . 1 ±1	0 0 0 . 0 0 0 ±1

TF 2418		
RANGE SWITCH SETTINGS	DISPLAYS	
	FREQ.	PERIOD
1	0 0 0 0 . 1 ±1	0 0 0 . 0 1 ±1
10	0 0 0 . 1 0 ±1	0 0 0 . 1 0 ±1
10^2	0 0 . 1 0 0 ±1	0 0 1 . 0 0 ±1
10^3	0 1 0 0 . 0 ±1	0 1 0 . 0 0 ±1
10^4	1 0 0 . 0 0 ±1	1 0 0 . 0 0 ±1
10^5	0 0 . 0 0 0 ±1	0 0 0 . 0 0 ±1
10^6	0 0 0 0 . 0 ±1	0 0 0 . 0 0 ±1

Table 2.1 Test Function Displays

NOTE In the RANGE SWITCH SETTINGS listed above for each model, the blue scale-markings ($1, 10, 10^2$... intended for PERIOD function) are used to identify the control positions.

2.6 OPERATING PROCEDURE

Measurements may be taken immediately after the supply has been switched on; however, for the accuracy of results to conform to the specification a period of at least fifteen minutes (for temperature stabilization of the internal reference oscillator circuit) should elapse before a measurement is taken.

No warm-up period is necessary for COUNT function or when an external standard frequency is used as reference source; in both circumstances the internal oscillator is unused.

2.7 FREQUENCY MEASUREMENT

2.7.1 Principle of Operation

In this function the setting of the rotary range switch determines which of several signal frequencies, derived from the standard frequency reference source, will control the internal gate; its setting therefore determines the gating time.

For the duration of the gating time, cycles of the A-INPUT frequency pass through the gate to a chain of counter/indicator-drive circuits. The indicators display the resultant count; where appropriate a decimal point is included in the display so that the readout is shown in Hz, kHz or MHz.

2.7.2 Measurement Procedure

(1) Set the rear-mounted STD switch to INT if the internal oscillator is to function as reference source; if an external reference source is to be used, set the switch to EXT and refer to Chapter 2.4 (REAR PANEL).

(2) If a data logging output facility is to be used refer to Chapter 2.13.

(3) Set the DISPLAY TIMER and STORE push-button as required (for control functions refer to Chapter 2.4(7) and Chapter 2.4(9).

(4) Apply the input signal to the coaxial A-INPUT socket and set the adjacent toggle switch to the required position (for control function refer to Chapter 2.4(4)(5) and (6).

(5) Depress the FREQ push-button.

(6) Set the range switch to a gating time for which the result will lie within the count capacity of the instrument (when the order of the input frequency is unknown the shortest gating time may be used first and the measurement then repeated on progressively lower ranges until the value is suitably resolved). The gating times for the range switch positions (in clockwise order) are listed below: the units of measurement for the various positions on frequency function are marked in black on the front panel.

(7) If the DISPLAY TIMER is set to INF momentarily depress the RESET push-button.

(8) Adjust the setting of the TRIGGER LEVEL control to suit the input waveform (for control use refer to Chapter 2.4(4)(5) and (6). After a brief counting period the result of the measurement should be displayed.

TF 2417			TF 2418	
Range switch position	Time		Range switch position	Time
1 (COUNT*)	-		1 MHz	10μs
2 MHz	1μs		2 MHz	100μs
3 MHz	10μs		3 MHz	1ms
4 MHz	100μs		4 kHz	10ms
5 MHz	1ms		5 kHz	100ms
6 kHz	10ms		6 kHz	1s
7 kHz	100ms		7 Hz	10s
8 kHz	1s			
9 Hz	10s			
The first position is not applicable to FREQ. function				

Table 2.2 Gating Time

2.8 PERIOD/MULTI-PERIOD MEASUREMENT

NOTE On PERIOD function single period measurement is catered for by the range switch setting...

TF 2418 position marked '1' (for which the count is recorded in 10μs units)

TF 2417 position marked '1' (for which the count is recorded in 1μs units)

Single period measurement may be taken also on function TIME B→C (with sockets 'B' and 'C' linked for single line gate control: refer to Chapter 2.9.2) for which the time unit is selectable.

2.8.1 Principle of Operation

In this function, signals applied to the A-INPUT control the internal gate. The gate is held open for one or more periods of the input waveform according to the range switch setting. The number of periods 'n' is shown by the switch setting; for example, 10^2. Throughout the gating time, pulses derived from the reference frequency source (which occur at a rate of TF 2418 - one per ten microsecond, TF 2417 - one per microsecond) pass through the gate to a chain of counter/indicator drive circuits. The resultant readout is the time for which the gate was held open and is a period or multi-period measurement (according to the range switch setting) of the input waveform.

2.8.2 Measurement Procedure

(1) Carry out procedures (1), (2) (3) and (4) of Chapter 2.7.2.

(2) Depress the 'PERIOD' push-button.

(3) Set the range switch.

Initially this switch should be set so that the measurement will lie within the count capacity of the instrument; subsequent measurements may then be taken on progressively lower ranges until the value is suitably received.

The blue scale of the range switch is applicable to PERIOD function. The range switch setting determines the number(n) of A-INPUT signal periods that are timed; the total time is therefore given by nA where A is the signal period.

The capacity of each instrument is

TF2417 - 999.999ms and TF2418 - 999.99ms

(4) If the DISPLAY TIMER is set to INF momentarily depress the RESET push-button.

(5) Adjust the setting of the TRIGGER LEVEL control to suit the input waveform (for control use refer to Chapter 2.4(4)(5)and(6). After a brief counting period the result of the measurement should be displayed.

To obtain the time corresponding to a single period of the input waveform, the readout should be divided by the value of 'n' to which the range switch is set.

Measurement Example:-

In the example below figures are given for TF 2417 and corresponding figures for TF 2418 are shown bracketed.

Consider an input frequency in the order of 10kHz whose period is 0.10234567ms. If a measurement were taken first on the range n = 1 the resultant display would be 000.102ms* (000.10ms*). If the range n = 10^5 were then used, the count capacity would be exceeded ten times during the measurement and the resultant readout would be 234.567ms* (234.56ms*). Because this readout was obtained over 10^5 periods of the input waveform it should be divided by 10^5 to provide the value 0.00234567ms (0.0023456ms) for one period. The first two digits determined on the first range, but occurring as overflow digits on the range 10^5, should then be appended to give 0.10234567ms (0.1023456ms) as the period of the input signal.

* The display accuracy is specified in Chapter 1.2.

2.9 TIMING

2.9.1 Principle of Operation

On 'TIME B→C' the gate is opened by a signal received at the 'B-INPUT' or by depression of the START push-button: it is closed by a signal received at the C-INPUT or by depression of the STOP push-button.

Throughout the gating time, pulses derived from the standard frequency reference source pass through the gate and through a frequency divider chain to counter/indicator-drive circuits. The range switch setting determines the effective division factor of the frequency divider chain and, therefore, the time unit of the count. Where appropriate a decimal point is included in the display so that the readout is in milliseconds or seconds according to the setting of the range switch.

Results displayed on the highest range (s x 10) should be multiplied by ten for the measurement to be in seconds; thus, for example, a displayed count of ten should read as 100 seconds.

2.9.2 Measurement Procedure

(1) Carry out procedures (1), (2) and (3) of Chapter 2.7.2.

(2) Set the range switch for the required time unit.

For clockwise rotation of the range switch the time units are:

TF 2418 - 10μs to 10s in decade steps

TF 2417 - 1μs (2nd position) to 10s in decade steps

(3) Gating may be started and stopped manually by use of the appropriate push-buttons, or electronically by signals applied to the START-B and STOP-C sockets; alternatively the gate may be opened by one method and closed by the other. The sockets may be connected in parallel if single line gate control is required; then, the first of two successive signals on the line will open the gate and the second will close it. External leads to the START-B and STOP-C sockets should be as short as practicable and screened to minimise pick-up which otherwise might cause unwanted trigger operation. It is recommended that where practicable, external trigger circuits for these inputs be battery powered to eliminate the possibility of the instrument being triggered by spurious mains-initiated pulses or ripple.

2.10 COUNT (TF 2417 only)

2.10.1 Principle of Operation

On this function gating may be started and stopped manually by depression of the B-START and C-STOP push-buttons, or electronically by signals applied to the START-B and STOP-C sockets; alternatively the gate may be opened by one method and closed by the other.

Throughout the gating time signals received at the A-INPUT socket pass through the gate to a chain of counter/indicator-drive circuits. The readout is therefore the number of A-INPUT signals received during the gating time.

2.10.2 Measurement Procedure

(1) Set the range switch to count

(2) Carry out procedures (2), (3) and (4) of Chapter 2.7.2.

(3) Connect a coaxial signal cable to each rear-mounted socket

(START-B ; STOP-C) that is to be used for gate control.

The 'Notes' appearing in Chapter 2.9.2 are applicable also to this COUNT function.

(4) Momentarily depress the RESET push-button

(5) Set the TRIGGER LEVEL control to suit the input waveform (for control use refer to Chapter 2.4 (4)(5) and (6)

(6) To begin the gating period momentarily depress the B-START push-button or apply a signal to the START-B socket

(7) To end the gating period momentarily depress the C-STOP push-button or apply a signal to the STOP-C socket

NOTE The instrument will function in the COUNT mode whether a function selector push-button is depressed or not.

2.11 EXTERNAL REFERENCE FACILITY

When the rear-mounted switch marked STD is set to INT the internal oscillator is employed as reference frequency source.

When the STD switch is set to EXT the internal oscillator is switched out of circuit and signals, from an external source, applied to the 'EXT' socket serve as reference signals for the instrument.

The external reference facility may be used to...,

(i) increase the accuracy of the instrument: by use of an external reference source (TF 2418 - 100kHz, TF 2417 - 10MHz) whose accuracy is superior to that of the internal reference source (refer to Chapter 1.2)

(ii) alter the significance of the readout so that the instrument may be used for non-standard measurements: by use of an external reference source whose frequency is different from that specified for the internal source.

The facility may also be used for frequency ratio measurement; the subject is treated in the following section.

2.12 FREQUENCY RATIO MEASUREMENT

To conduct a frequency ratio measurement for signals from two sources proceed as follows.

(1) Set the rear-mounted STD switch to EXT

(2) Apply signals (f_s) from one source to the STD socket

(3) Apply signals (f_a) from the second source to the A INPUT socket and set the adjacent toggle switch to the required position (for control function refer to Chapter 2.4(4) (5) and (6)

(4) If a data logging output facility is to be used refer to Section 6.1.1

(5) Set the DISPLAY TIMER and STORE push-button as required (for control functions refer to Chapters 2.4(7) and 2.4(9)

(6) The measurement may be conducted on FREQUENCY or PERIOD function; the two functions are treated separately -

(a) Frequency Function:

When the FREQ A push-button is depressed, signals (of frequency f_S) applied to the 'STD' socket pass by way of a frequency divider chain to the gate control circuit. The gate is held open while a number of pulses, equal to the division factor of the chain, is received at the 'STD' socket. The division factor is indicated by the setting of the range (blue scale: $1, 10, 10^2 \ldots$).

Throughout the gating period, signals (of frequency f_a) applied to the A INPUT socket pass through the gate to the counter/indicator-drive circuits.

$$\text{The Displayed Count} = \frac{f_a}{f_s} \times \text{Division Factor}$$

The ratio $f_s : f_a$ is therefore given by:

$$\frac{\text{Division Factor}}{\text{Count}} : 1$$

Example

With the FREQ A push-button depressed, the range switch set to 10^4, f_S = 80kHz, f_a = 20kHz and a displayed count of 2500 the ratio f_S to f_a would be given by:

$$\frac{10^4}{2500} : 1$$

$$= \quad 4 : 1$$

(b) Period Function:

While the PERIOD push-button is depressed the gate is controlled by signals (of frequency f_a) applied at the A INPUT socket. These signals pass by way of a divider chain to the gate control circuit: the gate is held open while a number of pulses, equal to the division factor of the chain, is received at the A INPUT socket. The division factor is indicated by the setting of the range switch (blue scale: $1, 10, 10^2 \ldots$).

Throughout the gating time, signals (of frequency f_S) applied to the STD socket pass through the gate to the counter/indicator-drive circuits.

$$\text{The Displayed Count} = \frac{f_s}{f_a} \times \text{Division Factor}$$

The ratio $f_s : f_a$ is therefore given by:

$$\frac{\text{Count}}{\text{Division Factor}} : 1$$

Example

With the PERIOD push-button depressed, the range switch set to 10^3, f_S = 80kHz, f_a = 20kHz and a displayed count of 4000 the ratio would be given by:

$$\frac{4000}{10^3} : 1$$

$$= \quad 4 : 1$$

NOTE For either function 'a' or 'b', the range switch setting should be such that the count capacity is not exceeded. For maximum accuracy the displayed count should be the highest obtainable without exceeding the count capacity.

(7) Momentarily depress the RESET push-button

(8) Adjust the setting of the TRIGGER LEVEL control to suit the signal waveform applied at the A INPUT socket (for control use refer to Chapter 2.4(4) (5) and (6)

2.13 DATA OUTPUT FACILITY

Data Output is presented at an Amphenol 36-pin socket mounted on the rear panel. Each digit is presented in b.c.d 1-2-4-2 code (for signal specification refer to Chapter 1.2).

NOTE The data outputs are obtained from the count-storage circuits; therefore, with the 'STORE' push-button depressed the recording time of data logging equipment may extend up to the end of the subsequent gating period. When the 'STORE' push-button is in the released condition the recording time must not exceed the minimum display time of the instrument; this restriction ensures that data logging will be completed before the instrument is reset.

Connections at the output socket are as follows:

NOTE MSD = Most significant digit

LSD = Least significant digit

Serial Output presented in the order MSD to LSD	
PIN	FUNCTION
1	BCD 1
2	BCD 2
3	BCD 4
4	BCD 8
5	Clock Signal
10	Sequence Start Signal
35	Print/Punch Command O/P
36	Chassis-earth
Note - other pins unused	

Table 2.3 TF 2417/3 and TF 2418/3 Serial Data Output

Pin No.	Function
1	MSD Line 1
2	MSD Line 2
3	MSD Line 4
4	MSD Line 8
5	Unused
6	2nd MSD Line 1
7	2nd MSD Line 2
8	2nd MSD Line 4
9	2nd MSD Line 8
10	Unused
11	3rd MSD Line 1
12	3rd MSD Line 2
13	3rd MSD Line 4
14	3rd MSD Line 8
15	Unused
16	4th MSD Line 1
17	4th MSD Line 2
18	4th MSD Line 4

Pin No.	Function
19	4th MSD Line 8
20	Unused
21	5th MSD Line 1
22	5th MSD Line 2
23	5th MSD Line 4
24	5th MSD Line 8
25	Unused
26	6th MSD Line 1
27	6th MSD Line 2
28	6th MSD Line 4
29	6th MSD Line 8
30	Unused
31	Unused
32	Unused
33	Unused
34	Unused
35	Print/Punch Command O/P
36	Chassis-earth

Table 2.4 TF 2417/4 and TF 2418/4 Parallel Data Output

Chapter 3

Technical description

3.1 INTRODUCTION

A MAIN ASSEMBLY diagram is provided for each model; it depicts the baseboard and various modules in block schematic form and shows how they are interconnected. Separate circuit diagrams are provided for the baseboard of each model and for each type of module.

On circuits of modules employing multi-element integrated circuits, each element is represented by a D-shaped symbol containing the component reference of the particular integrated circuit of which it is part. Within this circuit description such elements are distinguished from others of the same integrated circuit by means of their output connection numbers, which appear bracketed and as suffixes to the component reference of the 'parent' integrated circuit. In diagram E69/49 four elements, each bearing the reference X1 of the 'parent' integrated circuit, are shown in the area marked SECTION D; the element connected to R40 would be distinguished by the textual reference 'X1(11)' and those above it, reading from left to right, as 'X1(3)', 'X1(6)' and 'X1(8)'.

The PULSE SHAPER & PRE-AMPLIFIER, POWER SUPPLY, and REAR PANEL modules are common to both models of the instrument. Different types of module exist only for the BASEBOARD, COUNTER & DISPLAY circuit, and FRONT PANEL ASSEMBLY but the two types of each model are very similar.

3.2 SUPPLY CIRCUIT

Diagram E69/54 shows the circuit of the rear-panel-mounted components.

The input connections of the supply cable are depicted by the points L (live), N (neutral) and E (chassis-earth). The supply passes via the double-pole push-button-operated POWER switch S1, fuse FS1 and the suppressor circuit comprising L1,2/C5 a-c. The supply is then applied to the POWER SUPPLY UNIT type 77/230, the circuit of which is shown on diagram E69/52.

The mains supply is received at transformer T1, the primary windings of which should have been appropriately linked to suit the supply voltage: series connected for 200-250V a.c. or parallel connected for 100-125V a.c. (For transformer connection refer to Chapter 2.3.1).

Three low tension stabilized supplies are produced by the power unit.

(i) +13V*available at pin 8, derived via full-wave rectifying diodes D 2 & 3 and integrated circuit X1, and preset by control R2

(ii) +5V*available at pin 9 and derived via diodes D2 & 3, resistor R8 and integrated circuit X2

(iii) -16V*available at pin 14, derived via full-wave rectifier D4 & 5, fuse FS1 and the series stabilizer circuit of TR1-3, which is controlled by the voltage produced at potential divider junction R6/R7.

One unstabilized high tension supply of +242V* is produced by the power unit. It is derived via full-wave rectifiers D1 & 6 and is smoothed by C3.

The common line of the four supplied (0V: chassis-earth) is connected to pin 3.

* With respect to chassis-earth; for voltage tolerance refer to Chapter 4.3.1.

3.3 PULSE SHAPER AND PRE-AMPLIFIER TYPE 77/331 (Diagram E69/49)

PRE-AMPLIFIER signals received at the A-Input socket SK1 pass to the input network in which C1 acts as coupling capacitor and R5/C4 provide compensated ballast for clipping diodes D1 and D2.

When the TRIGGER LEVEL control is turned fully clockwise its ganged switch S1 brings C5 into circuit to establish low pass filter action.

The clipping diodes D1 and D2 serve to confine the amplitude of signals, passed to the gate of a.c. - coupled field effect transistor TR1, to within $\pm$1V.

A trigger level control voltage for the gate circuit of TR1 is derived from the +13V supply by the potential divider comprising R2 and preset potentiometer R1.

At junction R7-C7 the trigger level control voltage combines with feedback, received via R8, from the subsequent pulse shaper stage. The trigger level control circuit is such that movement of R1-slider from mid-position to either end of its track should cause the d.c. output level of the pre-amplifier, at TR3-collector, to change by approximately $\pm$1V.

The pre-amplifier comprises TR1 as source follower and TR2/TR3 arranged as a two-stage compound negative feedback amplifier. The d.c. gain of the pre-amplifier is set to approximately 10 by means of R14, R15 and R17. The overall gain for either setting of the sensitivity switch S2 is approximately 1.5.

FEEDBACK AMPLIFIER

The circuit of TR4 functions as d.c. bias feedback amplifier and employs R42/C13 and R24/C14,15 as signal integrators; its output passes to R8 of the pre-amplifier stage.

The feedback voltage from the amplifier is adjustable by means of R22, the setting of which is treated in Chapter 4.3.2.

SHAPER CIRCUIT

Signals from TR3-collector feed the circuit of p-n-p transistor TR5, which serves as input buffer/emitter follower, and temperature compensates the base circuit of TR6 for stability of the pulse shaper trigger level threshold.

The pulse shaper consists primarily of TR6/TR7 in a configuration similar to that of a Schmitt trigger circuit but with the two transistors directly coupled for high speed operation. Diode D6 permits the collector voltage of TR6 to swing positive by approximately 1.5V without attenuation of TR6 emitter current. The low value of common emitter resistor R35 enables the threshold differential of the trigger circuit to lie within the ranges approximately 300 to 400mV.

The pulse shaper output from TR7-collector drives emitter follower TR8, which acts as buffer and interfacer for integrated circuit X1 of the BASEBOARD. The signals pass by way of LINK F and termination A (Drg.E69/49) to baseboard termination 59.

3.4 OSCILLATOR AND EXTERNAL REFERENCE CIRCUIT

OSCILLATOR

Different types of crystal controlled oscillator are used for the two instruments.

TF 2418 (Drg.E69/55)

In this model a 100kHz oscillator is employed. The circuit contains crystal XL1, preset trimmer capacitor and transistors TR13 and TR14. The output signals of the oscillator are produced at the junction C35/R106 and serve as internal reference signals for the instrument.

TF 2417 (Drg.E69/58)

In TF 2417 a 10MHz oscillator is used as reference frequency source. It contains transistors TR13 and TR14, crystal XL1 and preset trimmer C23. The oscillator drives the integrated circuit frequency divider decade X11 so that 1MHz signals are produced at X11-pin 12 for use as internal reference signals within the instrument.

The internal reference signals pass by way of inverter X10(3) resistor R50 and termination 45 to the TEST output socket (SK1 on the FRONT PANEL ASSEMBLY diagram). The reference signals are also applied to one stage (input 9) of twin Schmitt trigger integrated circuit X9, which serves as pulse shaper; however,this stage is held inoperative when X9-pins 12 & 13 are connected to chassis-earth, which is the condition established when the STD switch (S2 on diagram E69/54) is set to the EXT (external) position.

Signals received at the STD external reference input socket (SK3 on diagram E69/54) are fed by way of the SCREEN 1 lead to a.c.-coupled inverter/amplifier TR15. The output signals of TR15 drive the second Schmitt trigger stage (input 5) of X9, which serves as pulse shaper for the external reference signals. This stage is held inoperative while X9-pins 1 & 2 are connected to chassis-earth; the condition established when the STD switch is set to INT (internal).

The outputs of the two Schmitt trigger/pulse shaper stages of X9 feed NAND-gate X10(11).

The setting of the STD switch determines which pulse shaper shall be operative and which inoperative; it thus determines from which source (internal or external) the reference signals shall be derived. The output potential of the inoperative shaper is such as to hold X10(11) enabled for the passage of the required signals.

The output signals of X10(11) pass via inverter X10(8) to X3-pin 8 of the FUNCTION CONTROL circuit-section.

Throughout the resetting period of the instrument the control potential at X9-pins 4 & 10 is such as to inhibit X9 so that it produces no further reference signal pulses until reset action has been completed.

3.5 DIVIDER CIRCUIT

The divider circuit comprises the large scale integrated circuits X4 and X5 and their associated components (refer to BASEBOARD circuit diagram).

Each integrated circuit contains two pairs of cascade-connected decades. The first pair; input 4, output 8. The second pair: input 14, output 9.

The four pairs are linked, as shown on the baseboard diagram, to form a chain of eight cascade-connected decades. The chain is fed by signals received, via amplifier TR4, from pins 1 and 13 of FUNCTION CONTROL integrated circuit X3.

By means of the potentials on control lines at terminations 25,26,33,34 and 36 any one of the decades may be selected to supply its output, via connection 2 and amplifier TR5, to FUNCTION CONTROL integrated circuit X2 and to X8(1)-pin 2 of the GATE CONTROL AND RESET circuit. Each control line of the divider circuits is either connected to the +13V supply line or left in the open circuit state by wafers S1a and S1b of the rotary range switch represented on the FRONT PANEL ASSEMBLY diagram.

When no frequency division is required to +13V supply potential is applied, by means of S1a rotor, to termination 35: no decade is then selected but instead transistor TR3 conducts so that the input signals by-pass the divider circuit.

Decade reset action is controlled by the circuit containing diodes D13-17. A positive-going reset pulse received at junction D16/D17 resets each decade to the nine state when diode gate D14/D16 is 'enabled' by a +13V potential at R100, or to the zero state when diode gate D15/D17 is enabled by a +13V potential at R101.

The circuit of TR6 serves to hold connection 5 of X4 and X5 at approximately 0V for part of the reset period; a condition necessary to achieve fast reset action of the decade chain.

3.6 GATE CONTROL AND RESET CIRCUIT

Integrated circuit X7 (of the BASEBOARD circuit) contains two inter-lock connected JK-flip-flops, which control the main signal gate of the instrument. The common 'clock' input (CLK) of the circuit receives the trigger pulses that initiate gating action.

The trigger pulses are received, by way of separate interfacing circuits, from different sources according to the particular function that the instrument is required to perform.

For functions FREQUENCY and PERIOD, pulses from the DIVIDER circuit pass to the clock input of the flip-flops via pins 2 and 1 of NAND-gate X8(1). For these functions the NAND-gate is held 'enabled' by its pin 3 potential, derived from the +13V supply via the corresponding function selection push-button and diode D11 and D10.

For function TIME B-C (and COUNT A/B-C of TF 2417) a 'start pulse': (i) received at the B-START socket (SK1 on diagram E69/54) and passed by way of a.c.-coupled input amplifier TR2 (diagram E69/54) or (ii) produced by depression of the B-START push-button S4 (baseboard circuit), is applied to the clock input of the flip-flops by way of X8(10)-pins 9 and 10; the NAND-gate being held enabled by the FUNCTION CONTROL circuit. Similar circuits, that of TR1 (diagram E69/54) and X8(13) and associated components of the baseboard, are provided for the 'stop pulse'. For the inhibit period of the instrument (during which time reset action occurs) start pulse NAND-gate X8(10) is inhibited by means of the potential produced at pin 3 of FUNCTION CONTROL integrated circuit X1, which holds transistor TR17 conductive.

The action of the dual flip-flop circuit X7 will now be considered. After a reset pulse has occurred at the 'clear' input to output logic levels are:- logic level '0' pins 7,10 and 12, logic level '1' pins 8,14 and 13.

The flip-flops having thus been reset, the first negative-going pulse (the 'start pulse') received at the 'clock' input triggers the first flip-flop so that the levels at its output pins inter-change: pins 7, 10 and 12 become '1' to enable NAND-gate X8(13); pin 13 becomes '0' to inhibit NAND-gate X8(10) and to present the complement of the gate-open-level (which may be represented thus: $\overline{\text{Gate open}}$ to X1(pin 10) and X3(pin 5) of the FUNCTION CONTROL circuit and to transistor TR2 so that it is cut-off for illumination of the GATING LAMP (LP1 of the FRONT PANEL ASSEMBLY circuit).

The second negative-going pulse (the 'stop pulse') received at the 'clock' input, triggers both flip-flops: pins 7, 10 and 12 become '0' to inhibit NAND-GATE X8(13), pin 13 becomes '1' to remove the $\overline{\text{Gate-open}}$ signal level (the GATE LAMP is therefore switched OFF) and pins 8 and 14 become '0' to provide a negative-going signal that serves as 'data transfer trigger signal' and is used as 'print/punch command pulse' when the instrument carries the serial data output facility.

Until reset action again occurs both flip-flops remain insensitive to further input signals via the 'clock' input because each flip-flop is inhibited by the other.

During the operation of the flip-flops for function TIME B-C (and COUNT A/B - C of TF 2417), integrator C19/R76 serves to delay the inhibiting feedback to NAND-gate X8(10) so that the first trigger signal at the 'clock' input is sustained sufficiently long to permit completion of the flip-flop trigger action. Integrator C20/R78 serves to delay the enabling feedback to NAND-gate X8(13) and ensures that the initial trigger action of the flip-flop circuit is completed before a stop signal may be received via this NAND-gate.

3.7 DISPLAY TIMING, INHIBIT TIMING AND RESET CIRCUITS

The negative-going signal produced (at the end of the main gating period) at pins 8 and 14 of baseboard integrated circuit X7, triggers the display time monostable circuit containing NAND-gate X6(3), transistors TR7 and TR8, and the DISPLAY TIMER potentiometer connected to termination 28 and represented as R1 (with its ganged switch S2) on the FRONT PANEL ASSEMBLY circuit diagram.

During the stable state of the monostable, X6(3) is held enabled by the emitter potential of TR8. As the circuit is triggered the output of X6(3) swings to logic level '1', which cuts-off TR7 and TR8 collector currents; diode D20 clamps input 2 of X6(3) at approximately 0V.

Provided that the ganged switch of the DISPLAY TIMER potentiometer is not set to INF (Infinity: switch open) C9 discharges via R51 and the potentiometer (whose setting determines the capacitor discharge time and consequently the display time of the instrument).

Transistor TR7 becomes conductive when junction C9/R51 tends negative with respect to the emitter; therefore, TR8 conducts and X6(3) output swings to '0' thus hastening completion of C9 discharge and triggering of the inhibit monostable by way of C12/D23.

The inhibit monostable, containing NAND-gate X6(8) and transistor TR9, may also be triggered by a similar negative-going signal produced upon depression of the RESET push-button S1 and received by way of C11/D22.

As the inhibit monostable is triggered, X6(8) output swings to '1' and presents a positive-going inhibit signal to pins 2 and 12 of FUNCTION CONTROL integrated circuit X1. The change in input level of X6(8) causes TR9 to conduct and supply a negative-going pulse via C14 for momentary cut-off of TR11 and TR10 collector currents. Three pulses are thus produced: a positive-going pulse (amplitude approx. 12V) at termination 6 (MOS Reset), a positive-going pulse(amplitude approx. 5V)at TR10-emitter (on TF 2418 this feeds the

TTL RESET line at termination 9), and a negative-going pulse (amplitude approx. 2.5V) at X6(11) pin 11 (on TF 2418 this feeds the TTL reset line at termination 9). The duration of the three pulses is approximately 25μs.

At the end of the inhibit period (approx. 4ms, determined by the charging time of C13) TR0 is cut-off and its collector applies logic level '1' to input 10 of XS(8), so that the output of the NAND-gate reverts to '0' for removal of the inhibit signal from X1 - pins 2 and 12.

3.8 FUNCTION SELECTION CIRCUIT

The instrument employs a number of signal gates that are contained in integrated circuits X1 to X3 of the BASEBOARD circuit. These gates are opened (enabled) or closed (inhibited) in different combinations according to the function that the instrument is required to perform.

Whether a gate is enabled or inhibited is determined by the potential applied to its control input(s). The gates are controlled primarily by wafers 'b' of the function selector push-buttons S5 to S7 and the diode-gate circuits employing D6 to D11; for example, when the TIME push-button S7 is depressed the +13V supply potential is applied to diodes D6 and D8 which conduct to apply enabling potentials to X1-pin 1, X3-pin 2 and X3-pin 6. Similar enabling potentials are applied to these and/or other control pins of the integrated circuits when the other function push-buttons are separately depressed.

The main input and output signals of the gating network comprising X1 to X3 are:

Inputs

Pin	Signal
X1-pin 4	'A-Input' (via Pulse Shaper & Pre-Amp.)
X3-pin 8	Reference frequency (internal or external)
X2-pin 10 TF 2417 X2 pin 9 TF 2418	Output of DIVIDER circuit
X1-pin 10 X3-pin 5	Main gating signal ($\overline{\text{Gate control}}$)

Outputs

Pin	Signal
X3-pins 1 & 13	Pulses to input of DIVIDER
X2-pins 3,8 & 11 TF 2417 X2-pins 1, 10 & 13 TF 2418	Pulses to COUNTER & DISPLAY

Table 3.1 Gating Network input & output signals

By means of the control potentials applied to the gating network the input signals are appropriately routed for the selected function; for example, on FREQUENCY function the reference frequency feeds the DIVIDER circuit, and the main gating signal (produced by the DIVIDER output) determines the duration for which the amplifier and shaped A-input pulses feed the COUNTER AND DISPLAY circuit.

The action of the gating network comprising X1 to X3 is indicated in Table 5.3 where, for each function, control potentials and input and output signals are represented for the 'main gating period' and for the 'inhibit period' of the instrument.

NOTE The following abbreviations are used:

A_f : A-Input frequency received via the PRE-AMP & PULSE SHAPER (rectangular waveform)

C_d : COUNTER & DISPLAY drive pulses

D_o : DIVIDER OUTPUT pulses

R_f : Reference frequency

T : Main gating time

I.C. : Integrated circuit

Control Line Logic Levels:

'0' : approx. -0.6V

'1' : approx. +5V

For X2 the type of integrated circuit fitted (and therefore the pin connections used) depends upon the instrument model. Pin numbers applicable to X2 of TF 2418 are shown bracketed.

TF 2417 (COUNT):

On COUNT mode the circuits of the function selector push-buttons are overridden by the range selector, which applies the +13V supply potential to BASEBOARD terminations 66, 67 and 68. This ensures that the appropriate gating combination is established at the gating network (X1 to X3) and that the +13V potential is present at the B-START and C-STOP push-buttons, irrespective of the condition of the three function control push-buttons.

In Table 5.3 only the main control signals and gating levels are shown for COUNT; those at other pins are immaterial and depend upon the condition of the function control push-buttons.

3.9 COUNTER & DISPLAY CIRCUIT

Different types of COUNTER AND DISPLAY module are used for the two models of the instrument: type 77/745 in TF 2418 and type 77/750 in TF 2417. As the two circuits are basically alike, only that of module type 77/750 will be described. The main circuit variations for type 77/745 lie in the omission of certain counter and numerical indicator circuits; the display of TF 2418 being restricted to five digits

Module type 77/750 (Diagram E69/60):

The module is initially reset by the MOS RESET pulse received at termination 6 and by the $\overline{\text{TTL RESET}}$ pulse received at termination 9.

Counter input pulses are received at termination 8 and drive a chain of six cascade-connected decades comprising VHF (or least significant digit) TTL integrated circuit X2 and MOS double decade/store integrated circuits X3, X4 and X5; the second decade/store of X5 forms an unused seventh stage, interfacing for output pulses of the TTL decade to drive the cascade-connected MOS decades, is provided by the circuit of TR2 and TR17.

Integrated circuit X1 serves as a store for count information received in bcd form (via inputs 3, 6, 2 and 7) from decade X2; equivalent store circuits for the other decades are contained within X3 to X5.

The potential applied to termination 7 controls store X1: when it is held at approximately +13V the bcd output information of X2 is present also at the output of X1 (outputs 1,14,11,8); when it is changed to approximately 0V the bcd information existing at the output of X1 is sustained (store condition) and X1 is held insensitive to changes in the output information of decade X2.

The store circuits of the other decades are similarly controlled by the potential at termination 7. This control potential is provided by the circuit of TR12 and TR16 of the baseboard. Transistor TR12 is held cut-off while STORE push-button S2 is in the released condition; the resultant control potential is then approximately +13V. When the push-button is depressed (STORE condition) TR12 conducts (control potential approx. 0V) but the transistor is momentarily cut-off (to provide a positive-going 'data-transfer pulse' at termination 7) at the end of each gating period by the 'data-transfer trigger signal' received via C15. For reset action to be effected when the STORE condition is not selected (S2 out), TR16 momentarily conducts to simulate the store condition so that while the decades (of drg.E69/60) are reset to zero they are not loaded by the stores; when baseboard transistor TR16 is again cut-off the stores aquire the zero condition.

The store associated with any one of the counter decades may be selected for its four bcd output lines to feed inputs 6,7,15 and 14 of integrated circuit b.c.d/decimal converter X6, where the count information is received in 1-2-4-8 bcd complement form. The stores are selected by means of control lines from the anodes of diodes D20 (for the least significant digit decade) D18,D16,D14,D12 and D10 (for the most significant digit decade). When D20 anode is held at approximately +13V the four diode gates containing D1 to D8 are 'enabled' for the information of store X1 to pass in bcd form to X6. Similar circuits for the other decade stores are contained within X3, X4 and X5.

The stores are scanned (selected in turn) by means of a pulse that progresses around the six-stage ring circuit of transistors TR4, TR6, TR8, TR10, TR12 and TR15; each stage effectively operates as a half-monostable circuit.

The six-stage ring circuit is set into operation (as the instrument is switched on) by the SCAN STARTER relaxation oscillator circuit of neon-tube V1. A negative-going pulse from the oscillator passes by way of C7 and cuts-off TR12 collector current for a period determined by the time constant C7 x R41. For this period D18-anode is held at approximately +13V for selection of the second least-significant-digit store, and transistor TR11 (connected to TR12 by Zener diode D17) conducts for indicator tube V6 to 'strike' and display the second least-significant-digit information (produced at X6-output and presented to all indicator tubes).

Decimal point control lines connected to terminations 1, 2 and 3 are operated appropriately by way of the range switch (S1 of the FRONT PANEL ASSEMBLY) and control push-buttons (S5, S6 and S7 of the BASEBOARD circuit).

Throughout the cut-off period of TR12 the other transistors of the six-stage ring circuit are held conductive and so hold display tubes V2-5 and

V7 in the non-illuminated condition.

At the end of the cut-off period TR12 conducts and a negative-going pulse passes via C14 to cut-off TR15. Thus the function of decade-store selection and display-tube illumination is passed to the next transistor of the six-stage ring circuit; therefore, the least-significant-digit is momentarily displayed. In this manner, all digits are in turn displayed and the proces, being controlled by a ring circuit, is recurrent.

Transistors TR14 and TR16 serve to permit only one pulse to circulate around the ring. During the scanning of the second-least-significant to fourth least-significant digits, one or another of transistors TR12, TR15, TR4, TR6 and TR8 is non-conductive and so provides bias (via R43, R48, R26...) to hold TR16 conductive; TR10 is also conductive during this time and holds TR14 cut-off. When the fourth-least significant digit has been displayed and TR8 again conducts, and provided that none of the transistors TR12, TR15, TR4 and TR6 is held non-conductive by a further pulse in the ring, TR16 base bias is automatically removed. Transistor TR16 is therefore held cut-off and the circulating pulse cuts-off TR10, which in turn causes TR14 to conduct thus 'inhibiting' receipt of any further pulse from TR8 during the cycle. Subsequently the circulating pulse is passed from TR10 to TR12; whereupon TR16 base bias is restored.

Termination 5 is normally held at approximately 0V by the BASEBOARD circuit of TR1. When more than one function selection push-button is depressed (an incorrect setting of the controls) the condition is detected by current-weighting resistors R19-R20 (connected to TR1 base) and TR1 collector swings positive to hold D21 (diagram E69/60) conductive, which in turn holds TR16 conductive; the normal action of the scanning circuit is thus inhibited and so no pulse can pass from TR10 to TR12.

The display circuit (diagram E69/60) contains ballast resistors R51 and R52. Once the scanning circuit has been set into operation, the relaxation oscillator circuit of V1 is effectively switched off by the potential developed across R51/R52 as they pass the indicator tube current. However, while the ring or scanning circuit is inhibited no tube current flows via R51/R52 and so the relaxation oscillator is free to operate and delivers pulses to the ring circuit; but because the period of oscillation is much greater than the time normally taken for a pulse to circulate the ring, the frequency of illumination of each indicator tube is relatively reduced and consequently the display appears dim.

3.10 DATA OUTPUT CIRCUITS

CONTROL SIGNAL CIRCUITS:

When either serial or parallel bcd output is provided the 'print/punch command signal' is obtained from pins 8 and 14 of BASEBOARD integrated circuit X7 (treated in Chapter 3.6).

For either form of BCD output a circuit producing SCAN MARKER PULSES and DIGIT MARKER PULSES is included in the instrument. These two marker pulse circuits are carried on a MARKER PULSE BOARD type 7700/13, which is secured to the power supply unit. Lead inter-connections for this board are shown in Fig.5.2 'BCD OUTPUT TO LEAD CONNECTION CHART'.

The marker pulse circuit is described below in relation to the MARKER PULSE BOARD circuit diagram E66/77.

Transistor TR2 is momentarily cut-off to produce a positive-going SCAN MARKER PULSE (or 'sequence start signal') when a negative-going potential change occurs at termination 12. This change is produced at COUNTER AND

DISPLAY board termination 12 when, at the start of each scanning cycle, the pulse circulating the ring circuit of the COUNTER AND DISPLAY circuit (treated in Chapter 3.9) passes to the most-significant-digit display control transistor.

Transistor TR1 momentarily conducts to produce a DIGIT MARKER PULSE (or 'clock signal') whenever the pulse circulating the ring circuit passes from one stage to the next and so causes a positive-going signal to occur at termination 13 of the COUNTER AND DISPLAY board.

For serial bcd output the SCAN MARKER and DIGIT MARKER pulses fed directly to the rear-mounted 36-pin output socket. For parallel bcd output these pulses are used to operate the PARALLEL BCD INTERFACE circuit described below.

DATA SIGNAL CIRCUITS:

(i) Serial bcd Output

For this form of output a SERIAL BCD INTERFACE board type 77/910 is fitted. The circuit of the board, shown on diagram E69/97, includes the marker pulse circuit (referred to above) and four inverters TR1 to TR4.

The inverters are operated in parallel by the BCD OUTPUT (lines $\overline{1}$, $\overline{2}$, $\overline{4}$ and $\overline{8}$) of the COUNTER AND DISPLAY BOARD. The outputs of the inverters feed the rear-mounted 36-pin socket where the data is presented in serial form in the order most-to-least-significicant digit.

(ii) Parallel bcd Output

For this form of output a PARALLEL BCD INTERFACE board type 77/900 is fitted (diagram E69/27). It contains four inverters TR4 to TR7 operated in parallel by the BCD OUTPUTS (lines $\overline{1}$, $\overline{2}$, $\overline{4}$ and $\overline{8}$) of the COUNTER AND DISPLAY board.

The inverters feed separate seven-stage integrated circuit shift registers (X1 to X4). The outputs of each register feed the rear-mounted 36-pin socket.

Operation of the four shift registers is controlled by integrated circuit X5, which contains two flip-flops externally linked for inter-lock action. This integrated circuit employs the auxiliary circuits of TR1 to TR3: the action of the interface circuit is as follows.

At the end of the gating period, a negative-going pulse (from BASEBOARD integrated circuit X7 pins 8 and 14) is received at termination 14 and serves to reset the inter-lock connected flip-flops of X5 and the four shift registers X1 to X4.

When the next scanning cycle is commenced, a SCAN MARKER PULSE (positive-going) is received at termination 16. The signal passes via inverter TR1 and triggers the flip-flop circuit; whereupon X5 output 8 swings from logic level '1' (the reset state) to logic level '0'. This logic level change 'enables' the circuit of the TR2 for control of the normally conductive inverter TR3.

As the first digit of the scanning cycle is selected for display (most significant digit) a DIGIT MARKER PULSE (negative-going) is received at termination 15. This pulse is differentiated by C2/R7-R8 and initiates momentary conduction by TR2 and consequently momentary cut-off of TR3 for the production of a positive-going pulse at TR3 collector: the pulse simultaneously clocks integrated circuits X1 to X4 so that each of the four 'bits' of the b.c.d. digit information are accepted into the first stage of their respective shift registers.

The four shift registers are progressively clocked, to store the remaining digits, as further DIGIT MARKER PULSES are received during the scanning cycle. At the end of the cycle a second SCAN MARKER PULSE is received at termination 16. This pulse triggers the flip-flop circuit: a negative-going potential change occurs at outputs 3, 9 and 14 (the signal feeds termination AA and serves as 'print/punch command' output signal) and output 8 swings back to logic level '1' to inhibit the circuit of TR2. The flip-flop circuit is then in the locked condition and remains insensitive to further SCAN MARKER PULSES until, at the end of a subsequent gating period of the instrument, another negative-going pulse is received at termination 14 whereupon reset action and a new cycle are initiated within the b.c.d. interface circuit.

Chapter 4

Maintenance

4.1 INTRODUCTION

This section contains information on preventative maintenance and performance checks to ensure that the instrument will continue to meet its specification.

The performance checks include sufficient adjustment procedure to cover the most important section of the specification, however performance limits quoted are for guidance only and should not be taken as guaranteed performance specification unless they are also quoted in the Data Summary section.

4.2 ACCESS AND LAYOUT

The instrument case is in two sections each secured by two screws at either side of the unit. Removal of the top section gives access to the power unit, printed circuit boards and preset controls: removal of the lower section gives access to the non-component side of the printed circuit baseboard and to the power unit fixing screws.

WARNING

Whenever the instrument is operated with the case removed, ensure that no physical contact is made with exposed connections: particularly those of the mains input circuit, transformer and +242V yellow lead

4.2.1 Fuse Replacement

A cartridge fuse, connected in the LIVE line of the mains input circuit, is housed in a screw type container accessible above the mains cable entry in the rear panel. The appropriate fuse rating depends upon the supply voltage:

Supply Voltage	Fuse Rating	Marconi Part Number
100-125V	600mA slow blow	TF-----/FPP/23402
200-250V	300mA slow blow	TF-----/FPP/23401

A cartridge fuse is connected in the -16V d.c. internal supply circuit; it is housed in a clip-type holder on the vertically mounted printed circuit board of the POWER UNIT. The fuse is accessible when the top section of the instrument case has been removed. Fuse : 250mA TF-----/FPP/23403

4.2.2 Plug-in Module Location

The position of the various plug in modules are indicated in layout diagram S71/47 and are listed in Table 4.1.

Type	Title	Quantity	
		TF 2417	TF 2418
2418	Baseboard	0	1
2417	Baseboard	1	0
77/012	Front Panel Assembly	0	1
77/013	Front Panel Assembly	1	0
77/022	Rear Panel	1	1
77/230	Power Supply	1	1
77/331	Pulse Shaper & Pre-Amp	1	1
77/745	Counter & Display	0	1
77/750	Counter & Display	1	0
For certain optional facilities the following cards are added -			
Type	Title	TF 2417/3 TF 2418/3	TF 2417/4 TF 2418/4
77/911	Serial B.C.D. Interface	1	
7700/13	Marker Pulse Board	1	1
77/910	Parallel B.C.D. Interface		1

Table 4.1 Plug-in Module Complement

4.3 PERFORMANCE CHECKS & ADJUSTMENT PROCEDURE

4.3.1 Preset D.C. supplies—Adjustment

Power unit type 77/230 provides three stabilized low tension supplies for the semiconductor circuits, and one unstabilized high tension supply for the digital indicator tubes.

The four supplies may be monitored at the miniature flying sockets that connect the printed circuit board of the power unit to the baseboard of the instrument. The appropriate sockets may be identified by their lead colours:

Red	:	+5V ±0.25V stabilized
Orange	:	+13V ±0.2V stabilized
Violet	:	-16V ±0.4V stabilized
Yellow	:	+242V ±15V unstabilized
Black	:	0V chassis (common to all four supplies)

NOTE — Recommended voltmeter: Universal AVO Meter Model 8. Observe meter range and supply polarity when connecting voltmeter.

The potential of the +5V line is not adjustable; that of the -16V line is dependent upon the potential of the +13V supply, which may be adjusted by means of power-unit-mounted preset potentiometer R2 (for control location refer to layout diagram S71/47). The potential of the +242V unstabilized supply is not adjustable.

4.3.2 Pulse Shaper Preset Control—Adjustment

NOTE — The instrument supply should be switched on for a stabilization period of at least five minutes prior to control adjustment.

The Pulse Shaper & Pre Amp. board type 77/331 carries one preset control: potentiometer R22. The control may be adjusted by means of a screwdriver or trimmer tool (for control location refer to layout diagram S71/47).

To adjust the control proceed as follows.

(1) Check that the knob of the TRIGGER LEVEL control is secured on its spindle such that the angular rotation available in clockwise and anti-clockwise directions about the centre mark (excluding the additional angular rotation for operation of the L.F. switch) are equal.

If necessary re-position and secure the knob: for knob removal refer to Chapter 5.3.1.

(2) Set the rear-mounted STD switch to INT, depress the FREQ push-button and set the range switch to:

TF 2418 10^4

TF 2417 10^5

(3) Apply a standard frequency sinusoidal 1kHz r.m.s. signal to the coaxial A INPUT socket.

(4) Set the DISPLAY TIMER to MIN and momentarily depress the RESET push-button.

At this juncture the GATE OPEN neon lamp should be flashing: indicating a fast and consistent cyclical gating action.

(5) Set the TRIGGER LEVEL control to the middle position and set the adjacent toggle switch to 10mV.

(6) Slowly turn Pulse Shaper potentiometer R22 clockwise and then anti-clockwise while observing the display. A recurrent result of 1.00 should be obtainable between two settings of the control. The control may be turned in either direction several times until the two positions are determined: then set the control midway between these two positions.

(7) Slowly turn the TRIGGER LEVEL control anti-clockwise while observing the display. At first the result should be 1.00 but a position should be reached for which the result changes to zero; note this position of the control. Now slowly turn the control clockwise, the result should revert to 1.00 but beyond the centre mark a position should be reached for which the result changes to 0.01; note this position. The two noted control positions should be approximately equi-distant about the centre mark on the panel. If necessary R22 may be re-adjusted to obtain the required performance of the TRIGGER LEVEL control.

4.3.3 Oscillator Preset Control—Adjustment

NOTE — The instrument supply should be switched on for a stabilization period of at least fifteen minutes prior to control adjustment

The preset trimmer capacitor of the internal reference oscillator is mounted on the baseboard near the rear-panel-mounted START-B socket (refer to layout diagram S71/47).

To adjust the preset trimmer proceed as follows.

(1) Set the rear-mounted STD switch to INT, depress the FREQ A push-button and set the range switch to '1' and the DISPLAY TIMER to INF.

(2) Connect one beam of a double-beam oscilloscope between the TEST output socket and chassis, and the second beam to a standard frequency source (100kHz for TF 2418, 1MHz for TF 2417) providing signals of amplitude suitable for oscilloscope display.

(3) Set the oscilloscope so that it is triggered by signals from the standard frequency source.

(4) Compare the oscilloscope traces and, by use of a suitable trimmer tool, adjust the setting of the trimmer until the drift of the TEST frequency (with respect to the standard frequency) lies well within the specified limits (refer to Chapter 1.2.3).

NOTE — If the TEST frequency changes as the tool is removed re-adjust the control, allowing for the effect of tool capacitance, so that the required frequency condition is obtained when the tool is removed

(5) Allow several minutes to elapse for oscillator stabilization, then check that the oscillator frequency still lies within the specified limits; if necessary repeat the procedure from (4) above.

Chapter 5

Repair

5.1 INTRODUCTION

This chapter of the manual, although not an exhaustive treatment of the subject of instrument repair, deals with certain fundamental procedures for fault location, with a number of malfunctions that could arise in the display system and with the procedure for consequent repair.

The location of the various modules is explained in Chapter 4.2.2 of the Maintenance section of this manual.

Performance limits quoted are for guidance only and should not be taken for guaranteed performance specification unless they are also quoted in the Data Summary Chapter 1.2.

In case of difficulties which cannot be resolved with the aid of this manual, please contact our Service Division at the address stated on the back cover, or to your nearest Marconi Instruments representative quoting the type and serial number of the instrument.

5.2 FAULT FINDING

In many cases, non-existant faults are due to incorrect settings, ensure therefore that the adjustment procedure outlined in Chapter 4.3 has been correctly carried out.

The nature of a fault will often be apparent from its symptoms (for example, a faulty readout tube or a gross error in the display time will be seen) and in general faults concerning decades, memory or readout will show in the display.

5.2.1 Internal Supply Voltages

Malfunction of the instrument can be caused by incorrect voltages of the internal supplies, therefore a check of the voltages should be made prior to specific circuit function investigation.

Reference to Chapter 3.2 should be made for a detailed description of the supply line source. Table 5.1 of this chapter provides a complete list of the interconnecting leads and the relevant internal supply voltages. Diagrams E69/56 (TF 2418) and E69/61 (TF 2417) indicates the instrument wiring layout in a block diagram presentation.

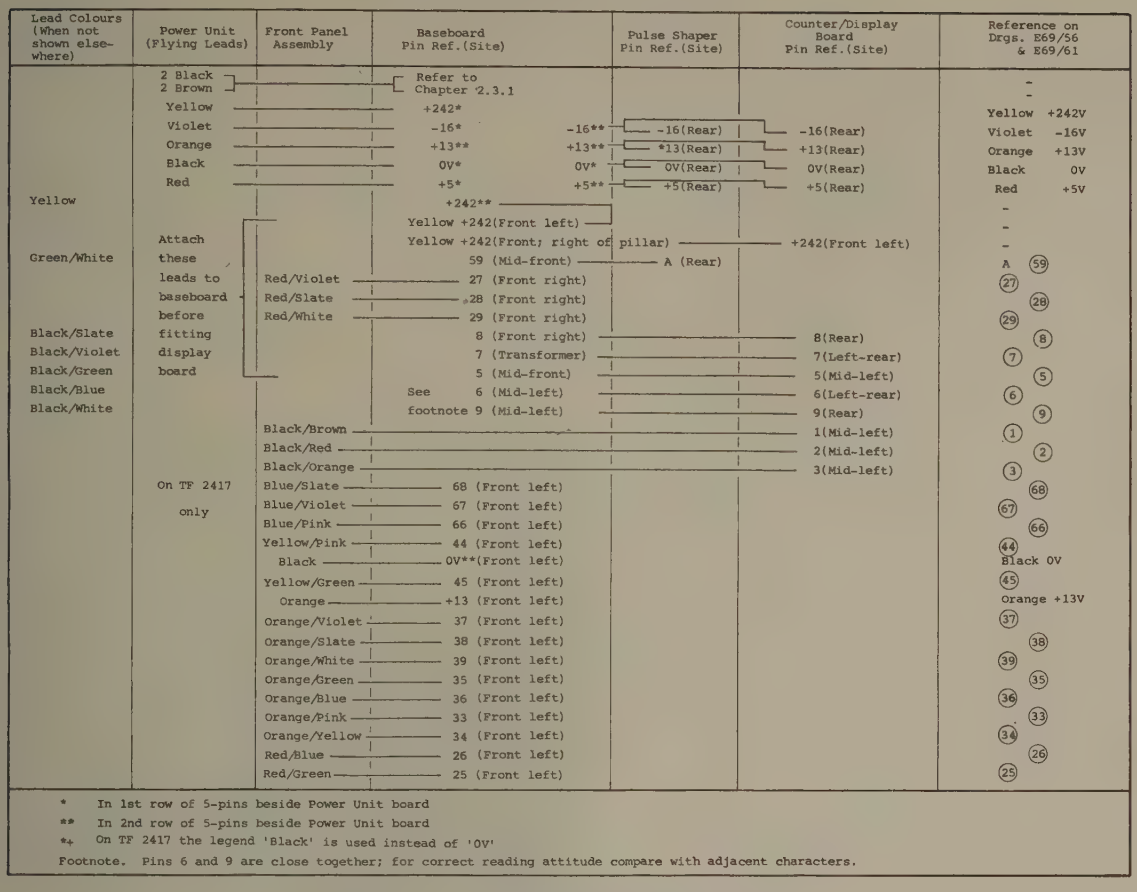
Measurement and adjustment of the internal supply voltages are outlined in Chapter 4.3.1.

5.2.2 Oscillator and Pulse Shaper Adjustment

If time dependent measurements are suspect the frequency of the reference oscillator should first be checked and if necessary adjusted (see Chapter 4.3.3).

When the oscillator frequency has been checked and incorrect results are still obtained on functions for which signals are received by way of the A INPUT socket, the setting of the Pulse Shaper control should be checked in accordance with Chapter 4.3.2.

NOTE. The terms 'left' and 'right' are valid when the instrument is viewed from the rear.



* In 1st row of 5-pins beside Power Unit board

** In 2nd row of 5-pins beside Power Unit board

*+ On TF 2417 the legend 'Black' is used instead of '0V'

Footnote. Pins 6 and 9 are close together; for correct reading attitude compare with adjacent characters.

Table 5.1 Lead Connection Chart

5.2.3 Control Line Voltages

The functions of the instrument are internally selected by a number of control lines which may be held at either of two logic states.

Logic state '1' - approx +5V
Logic state '0' - approx -0.6V

The particular voltage combination of these lines determines the instrument function and are shown in Table 5.3.

The abbreviation used in Table 5.3 are as follows.

A_f - A - Input frequency received via the PRE-AMP and PULSE SHAPER (rectangular waveform)

C_d - COUNTER and DISPLAY drive pulses

Do - DIVIDER OUTPUT pulses

R_f - Reference frequency

T - Main Gating Time

IC - Integrated circuit

Integrated circuit X2 type is dependant upon the instrument model. Pin numbers applicable to TF 2418 are shown bracketed.

For each function on which a fault condition is manifest, the control line voltages should be measured and checked against the corresponding voltage combination appearing in the table. This check should be carried out prior to investigation into the circuit operation of any individual module.

Circuit Diagrams E69/53 (TF 2418) and E69/59 (TF 2417) used in conjunction with the Main Assembly diagrams E69/56 (TF 2418) and E69/61 (TF 2417) provide the relationship between Table 5.3 and the Baseboard Circuit Diagrams E69/55 (TF 2418) and E69/58 (TF 2417).

For a detailed description of the "function control signals" and "gating levels" refer to Chapter 3.8.

5.3 DISMANTLING

Dismantlement of the instrument to give maximum access to the modules and their components is treated below. For case removal refer to Section 4.1. For module positions refer to layout diagram S71/47.

WARNING — Switch off the supply and disconnect the supply cable before commencing to dismantle the instrument.

5.3.1 Removal of Front Panel, Display Board and Pre-Amplifier

FRONT PANEL

(1) Remove the three control knobs.

Each control knob is secured by a screw clamp at the top of the knob in line with the end of the spindle: the screw head is covered by a cap that may be pulled out by means of the finger nails or a thin bladed implement.

NOTE — When the knob is later refitted refer to Chapter 4.3.2(1) for the necessary position.

(2) Withdraw the four panel-fixing screws (one near each corner of the panel) and remove the front panel.

(3) Withdraw the two sub-panel-fixing screws that lie respectively below the 'A INPUT' socket and at the top left of the TRIGGER LEVEL control.

(4) Uncouple the miniature flying sockets by which, leads from the range switch and gate lamp are united with plug-pins of the baseboard and display board.

(5) Gently pull forward the sub-front panel with its surround and allow it to hinge around on the leads from the DISPLAY TIMER.

DISPLAY

(6) Withdraw the four cross-grooved screws (each with one washer) that secure the horizontally mounted printed circuit display board to its mounting pillars; then carefully lift away the board. This board may be completely detached from the instrument by uncoupling the miniature flying socket by which leads from the baseboard are connected to it.

(7) To free the front panel assembly, uncouple the miniature flying sockets of the DISPLAY TIMER leads from their baseboard plug-pins.

PRE-AMP/PULSE SHAPER BOARD

(8) This board carries the A-INPUT controls and is mounted vertically on the right hand side plate of the instrument. Uncouple the flying sockets that connect leads from the baseboard to plug-pins of this board. Detach the board by withdrawing its two cross-grooved pillar-fixing screws from the right hand side plate.

Access to components of the A-INPUT circuit may be gained by removal of the U-shaped metal screen, which is secured to board-mounted pillars by two cross-grooved screws.

5.3.2 Rear Panel Removal

Withdraw the four rear-panel fixing screws (each with one washer) and pull back the panel assembly until it is unplugged from the main chassis-unit.

5.3.3 Power Unit Removal

WARNING

Ensure that the supply cable is disconnected from the mains before embarking upon power unit removal

(1) Uncouple the flying sockets that connect the power unit leads to plug-pins of the baseboard at either end of the module.

(2) From the underside of the instrument withdraw the four power unit fixing screws (identifiable by the four cable cleats that they also secure).

5.3.4 Data Output Board Removal

In instruments fitted with data output facility a plug-in board (type 77/910 for Serial o/p; type 77/900 for Parallel o/p) is mounted beside the POWER switch push-rod. It may be unplugged and withdrawn from the top of the instrument when the two countersunk screws (with spacers and nuts) that secure it to the adjacent side plate of the instrument have been removed.

In instruments carrying B.C.D output an additional board (type 7700/13) is fitted; it is secured by screws to the power unit module.

5.4 RE-ASSEMBLY LEAD CONNECTIONS

Refer to Table 5.1 Lead Connection Chart for this chapter.

When re-assembling the instrument, check that:

(i) The spindle of the POWER switch is located in the drilled end of its push-rod

(ii) All flying-lead connections to baseboard pins that lie beneath the display board, are established before the display board is secured

(iii) No lead is trapped or pinched when fixing screws are tightened

For inter-connection of the modules refer to the LEAD CONNECTION CHART; there the origins and destinations of the leads are shown under corresponding module headings.

Example : In the fourth row of the chart it may be seen that a flying lead (violet) has its origin at the Power Unit and connects onto a baseboard pin marked '-16'; also that a forked lead (violet), origin at a second baseboard pin marked '-16', has one end terminated at a Pulse Shaper board pin marked '-16' (sited near the rear of the board, as indicated in brackets) and the other end at a Counter/Display board pin marked '-16'.

For general lead inter-connection no reference need be made to the column on the extreme right of the chart; it is intended as an aid for fault tracing and shows how the leads are signified on the MAIN ASSEMBLY diagram of the instrument. The resistor colour code is adopted for bi-coloured leads such that their colouration corresponds to pin numbers, and to encircled lead numbers on the diagram: two rules apply...

(i) The low significant digit should be read first; for example, Brown/Black should be interpreted as 01 (one) not as 10 (ten).

(ii) Pink on a lead indicates that the digit represented by the accompanying colour should occur twice; for example Orange/Pink should be interpreted as 33.

Connection with the rear panel is made via a multi-way edge-connector that carries three screened leads. The screened leads are numbered 1, 2 and 3 on the MAIN ASSEMBLY diagram and, conforming to the resistor colour code, are respectively brown, red and orange.

5.5 PACKAGING FOR RESHIPMENT

In the event of the equipment being returned for servicing it should be packed in the original shipping carton and packing material. If this is not available wrap the instrument in heavy paper or plastic and place in a rigid outer box of wood, fibreboard or very strong corrugated cardboard. Use ample soft packing to prevent movement. Provide additional support for projecting parts to relieve these of unnecessary shock. Close the carton securely and seal with durable tape. Mark the shipping container FRAGILE to ensure careful handling.

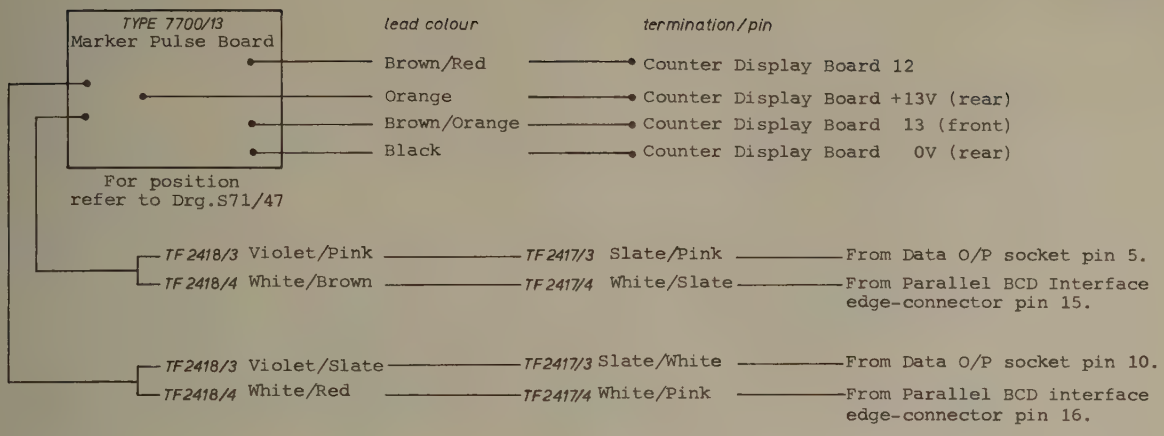


Fig. 5.2 BCD Output Lead Connection Chart

I.C.Pin No		Remarks	SELECTED FUNCTIONS							
			FREQ.	Inhibit period	PERIOD	Inhibit period	TIME	Inhibit period	COUNT (Model 7736)	Inhibit period
X1	1	Control for F & T	1	1	0	0	1	1		
	2,12	Inhibit	0	1	0	1	0	1		
	3	Inverted Inhibit	1	0	1	1	1	0		
	4	Signal input	A_f	A_f	A_f	A_f	A_f	A_f	A_f	A_f
	5,11	Inverted Inhibit	1	1	1	0	1	1		
	6	Signal output	A_f	A_f	A_f	0	A_f	A_f		
	8	Inverted '$\overline{\text{Gate Control}}$'	1 / 0 ⌐T⌐	0	1	1	1	1		
	9	Control for FREQ.	1	1	0	0	0	0	1	1
	10	Gate Control	1 / 0 ⌐T⌐	1	1 / 0 ⌐T⌐	1	1 / 0 ⌐T⌐	1		
	13	Control for PERIOD	0	0	1	1	0	0	0	0
X2	2,6 (3,4)	Signal output	A_f	A_f	A_f	0	A_f	A_f		
	3,8,11 (1,10,13)	Signal output	C_d	0	C_d	0	C_d	0	C_d	0
	9 (8)	Control for TIME	0	0	0	0	1	1		
	10 (9)	Signal input	D_o	1	D_o	1	D_o	1		
	13 (12)	Signal input	D_o	0	D_o	1	D_o	1		
X3	1,13	Signal output	R_f	1	A_f	1	R_f	1		
	4,9	Inverted '$\overline{\text{Gate Control}}$'	1	1	1 / 0 ⌐T⌐	0	1 / 0 ⌐T⌐	0		
	6	Control for P & T	0	0	1	1	1	1		
	8	Signal input	R_f	1	R_f	R_f	R_f	1		

Table 5.3 FUNCTION CONTROL SIGNALS AND GATING LEVELS

Chapter 6

Replaceable parts

6.1 INTRODUCTION

The TF 2417 and TF 2418 consist of similar sub-assemblies and are listed in the order shown below. In this chapter only, each sub-assembly is designated an identification in the sequence Y1 to Y12 as follows:-

Y1	Front Panel Assembly	(TF 2418)	Type 77/012	(Drg.E69/53)
Y2	Front Panel Assembly	(TF 2417)	Type 77/013	(Drg.E69/59)
Y3	Rear Panel Assembly		Type 77/022	(Drg.E69/54)
Y4	Power Supply		Type 77/230	(Drg.E69/52)
Y5	Pulse Shaper & Pre-Amp		Type 77/331	(Drg.E69/49)
Y6	Counter & Display	(TF 2418)	Type 77/745	(Drg.E69/57)
Y7	Counter & Display	(TF 2417)	Type 77/750	(Drg.E69/60)
Y8	Parallel BCD Interface	(TF 2417/4 & TF 2418/4)	Type 77/900	(Drg.E69/27)
Y9	Serial BCD Interface	(TF 2417/3 & TF 2418/3)	Type 77/910	(Drg.E69/33)
Y10	Marker Pulse Board	(TF 2417/3 & /4, TF 2418/3 & /4)	Type 7700/13	(Drg.E69/77)
Y11	Baseboard	(TF 2418)	Type 7735/10	(Drg.E69/55)
Y12	Baseboard	(TF 2417)	Type 7736/10	(Drg.E69/58)

For the purpose of ordering spares and to avoid ambiguity, the complete reference number of a part consists of the sub-assembly indicator number followed by the circuit reference number.

e.g. Y3/D1 is a U2973/2 whereas Y4/D1 is a BYX10

The circuit reference numbers are listed in alpha-numerical order. The following abbreviations are used:-

carb	carbon	pos	position (way)
D	diode	R	resistor
FS	fuse	S	switch
HS	high stability	SK	socket
L	inductor	T	transformer
Lin	linear	TR	transistor
LP	indicator lamp	V	neon display tube
Met	metal	W	watts
Min	miniature	X	integrated circuit
P	pole	XL	crystal

Note - All tolerances quoted are ± unless otherwise indicated. The OHM unit of resistance is not indicated in the following stock lists.

6.2 ORDERING

When ordering replacements or spare parts, address the order to -

Marconi Instruments Service Division
The Airport,
Luton, Bedfordshire

or to your nearest representative. Please specify the following information for each part required.

i) Type of instrument
ii) Circuit Reference Number e.g. Y3/R1
iii) Description e.g. 10kΩ 1/3W Carbon Film Resistor
iv) M.I. Part Number TF 2417 or TF 2418)/FPP/24058

If a part is not listed, state its function, location and descrption when ordering.

Spares supplied against M.I. Part Numbers are electricaly interchangeable with those originally fitted, but may not always be identical.

6.3 PARTS LIST

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Y1 - FRONT PANEL ASSEMBLY TF 2418 - TYPE 77/012 (DRG E69/53)			
Indicator lamp			
LP1	Neon	GATING lamp	23701
Variable resistor			
*R1	500k 20% 0.2W	Carbon Lin.	25002
Switches			
S1(a-e)	5P 7pos Rotary	RANGE	23106
*S2	1P ON/OFF	TRIG LEVEL	25002
Y2 FRONT PANEL ASSEMBLY TF 2417 - TYPE 77/013 (DRG E69/59)			
Same as Y1 (TF 2418) except			
S1(a-e)	5P 9pos Rotary	RANGE	23106
*S2	1P ON/OFF	TRIG LEVEL	25002
*R1 ganged to S2 (common part)			
Y3 - REAR PANEL ASSEMBLY TF 2417 & TF 2418 - TYPE 77/022 (DRG E69/54)			
Capacitors			
C1,2	22pF 10%	Ceramic	26024
C3,4	4.7nF 250V	Polymite	26022
C5a,b,c	0.1μF, 5nF, 5nF 250V	Suppressor	26001
Diodes			
D1,2	U2973/2		28101
Fuse			
FS1	300mA	Slow Blow	23401
FS2	600mA	Slow Blow	23402
Inductors			
L1,2		Mains choke	43201
Resistors			
R1,2	10k 5% 0.33W	Min. Carbon Film	24058
R3,4	5.6k 5% 0.33W	Min. Carbon Film	24078
Switches			
S1	2P ON/OFF	POWER push button	23103
S2	1P 2 position	STD toggle	23104
Sockets			
SK1-3	BNC	50ohms	23002

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Transistors			
TR1,2	V405A		28205
Y4 POWER SUPPLY TF 2417 & TF 2418 - TYPE 77/230 (DRG E69/52)			
Capacitors			
C1	1000µF	25V Electrolytic	26037
C2	470µF	40V Electrolytic	26038
C3	10µF	400V Electrolytic	26002
C4	15µF	16V Electrolytic	26007
C5	100µF	3V Electrolytic	26006
C6	47nF +50% -25%	Disc	26010
C7	15µF	Electrolytic	26039
Diodes			
D1,6	BYX10		28102
D2-5	1N4002		28103
Fuse			
FS1	250mA		23403
Resistors			
R1	470k 5%	1/4W HS Carbon	24011
R2	220 20%	1/4W Variable	25003
R3,5	470 5%	1/4W HS Carbon	24051
R4	680 5%	1/4W HS Carbon	24072
R6	2.4k 2%	1/4W HS Carbon	24079
R7	2.7k 2%	1/4W HS Carbon	24080
R8	22 5%	2W Metal Oxide	24081
Transformer			
T1	Mains transformer		43102
Transistor			
TR1	2N3054		28208
TR2,3	BC212L		28209
Integrated Circuits			
X1	L036T1		28401
X2	L005T1		28402

Circuit Reference	Type			Description	Marconi Part No. (TF..../FPP....)
Y5 PULSE SHAPER & PRE-AMP TF 2417 & TF 2418 - TYPE 77/330-333 (DRG E69/49)					
Capacitors					
C1	0.1µF	10%	400V	Met. Poly	26008
C2,11	3.3µF		16V	Tantalum	26009
C3,6-8 14/15	47nF	+50% -25%		Disc	26010
C4	60pF	10%		Sub. Min.	26040
C5	1000pF	20%		Sub. Min.	26012
C9	33pF		10V	Tantalum	26013
C10	100µF		3V	Tantalum	26006
C12	270pF	10%		Sub. Min.	26041
C13	1.5µF		63V	Electrolytic	26042
C16	47µF		10V	Electrolytic	26043
C17,19 20/21	47nF	+50% -25%		Disc	26010
C18	22µF		25V	Electrolytic	26044
Diodes					
D1,2	BAW62				28105
D3	BZY88/C7V5				28111
D4,5	BZY88/C4V7				28112
D6,7	U2973/2				28101
Resistors					
*R1	500k	20%	0.2W	Variable Carb. Lin.	25002
R2	56k	5%	0.33W	Carbon Film	24012
R3,21,41	10	5%	0.33W	Carbon Film	24013
R4,7,20	3.9M	10%	0.33W	Carbon Film	24014
R5	1M	5%	0.33W	Carbon Film	24015
R6	220k	5%	0.33W	Carbon Film	24016
R8	470k	5%	0.33W	Carbon Film	24017
R9	2.2k	5%	0.33W	Carbon Film	24018
R10	680	5%	0.33W	Carbon Film	24019
R11	100	5%	0.33W	Carbon Film	24020
R12	150	5%	0.33W	Carbon Film	24021
R13,17	820	5%	0.33W	Carbon Film	24022
R14	220	5%	0.33W	Carbon Film	24023
R15	1.5k	5%	0.33W	Carbon Film	24024
R16	47	5%	0.33W	Carbon Film	24025
R18	18k	5%	0.33W	Carbon Film	24026
R19	470	5%	0.33W	Carbon Film	24027
R22	2.2k	20%	0.2W	Variable Carb. Lin.	25005
R23	470	5%	1/4W HS	Carbon	24051
R24	1M	5%	1/4W HS	Carbon	24031
R25	3.3k	5%	1/4W HS	Carbon	24048
R26	15k	5%	1/4W HS	Carbon	24032
R27,35	10	5%	1/4W HS	Carbon	24036
R28,36	1k	5%	1/4W HS	Carbon	24033
R29,30	430	5%	1/4W HS	Carbon	24037
R31	100	5%	1/4W HS	Carbon	24039
R32	1.5k	5%	1/4W HS	Carbon	24029
R33	1.8k	5%	1/4W HS	Carbon	24034
R34	220	5%	1/4W HS	Carbon	24035
R37,40	47	5%	1/4W HS	Carbon	24045
R38,39	2.2k	5%	1/4W HS	Carbon	24040
R42	9.1k	5%	1/4W HS	Carbon	24028

* R1 ganged to S1 (common part)

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Switches			
*S1	1P ON/OFF		25002
S2	1P 2 pos	toggle	23104
Socket			
SK1	BNC	50 ohm	23003
Transistors			
TR1	2N5486		28203
TR2	BFY90		28204
TR3,6-9	U1518/2		28206
TR4,5	V405A		28205

*S1 ganged R1 (common part)

Y6 COUNTER & DISPLAY TF 2418 - TYPE 77/745 & 747 (DRG E69/57)

Capacitors					
C1-5 9-14	47nF	+50% -25%		Disc	26010
C6	0.1µF	10%	250V	Met. Film	26031
C7	0.01µF	10%	250V	Met. Film	26033
C8	0.22µF	10%	250V	Met. Film	26018
C15	56pF	5%		Ceramic	26028
Diodes					
D1-8	U2973/2				28101
D9,11,13	MZ92/91B				28109
D10,12,14	BYX10				28113
D15,17,19	MZ92/91B				28109
D16,18,20	BYX10				28113
D21	1N4009				28108
D22-26	U2973/2				28101
Resistors					
R1	6.8k	5%	0.33W	Min. Carb. Film	24082
R2	6.8k	5%	1/4W	Carbon	24071
R3	4.7k	5%	0.33W	Min. Carb. Film	24083
R4,5,17	10	5%	1/4W	Carbon	24036
R6-9	12k	5%	0.33W	Min. Carb. Film	24065
R10	470	5%	1/4W	Carbon	24051
R11	560	5%	1/4W	Carbon	24050
R14,15	1k	5%	0.33W	Min. Carb. Film	24084
R16	10	5%	0.33W	Min. Carb. Film	24013
R18,26,28	180k	5%	1/4W	Carbon	24074
R19	270k	5%	1/4W HS	Carbon	24075
R20	1M	5%	1/4W HS	Carbon	24031
R21	100k	5%	1/4W HS	Carbon	24007
R22,27,32	75k	5%	1/4W HS	Carbon	24076
R23,31,36	12k	5%	1/4W HS	Carbon	24009
R24,29,34	430	5%	1/4W HS	Carbon	24037
R25,30,35	680	5%	1/4W HS	Carbon	24072
R33,38,43	180k	5%	1/4W HS	Carbon	24074
R37,42,47	75k	5%	1/4W HS	Carbon	24076
R39,44,49	430	5%	1/4W HS	Carbon	24037

Circuit Reference	Type			Description	Marconi Part No. (TF..../FPP....)
Y6 Counter & Display TF 2418 (cont'd)					
Resistors					
R40,45,50	680	5%	1/4W HS	Carbon	24072
R41,46,57	12k	5%	1/4W HS	Carbon	24009
R48	180k				
R51,52	18k	5%	1 W	Carbon	24077
R53,54,56	22k	5%	0.33W	Min. Carb. Film	24061
R58	3.3k	5%	0.33W	Min. Carb. Film	24057
R59	1k	5%	0.33W	Min. Carb. Film	24084
R60	220	5%	0.33W	Min. Carb. Film	24023
R61-64	27k	5%	0.33W	Min. Carb. Film	24085
Transistors					
TR1,14,16	BC108				28201
TR2,17	U15718/2				28206
TR3-13,15	C407				28202
Indicators					
V1	16L			Neon lamp	23702
V2-7				Numicator tubes	28002
Integrated circuits					
X1	SN7475				28412
X2	SN7490				28407
X3,4,5	C16B/R1				28420
X6	9960				28416
Y7 COUNTER & DISPLAY TF 2417 - TYPE 77/750 (DRG E69/60)					
Capacitors					
Same as Y6 (TF 2418) except as follows					
C16	22pF	10%		Ceramic	26024
Diodes					
Same as Y6 (TF 2418)					
Resistors					
Same as Y6 (TF 2418) except as follows					
R1	6.8	5%	1/4W HS	Carbon	24071
R5	10	5%	0.33W	Min. Carb. Film	24013
R14	680	5%	0.33W	Min. Carb. Film	24019
R58	1k	5%	0.33W	Min. Carb. Film	24084
R59	470	5%	0.33W	Min. Carb. Film	24027
R60	22k	5%	0.33W	Min. Carb. Film	24061
Transistors					
Same as Y6 (TF 2418)					
Indicators					
Same as Y6 (TF 2418)					

Circuit Reference	Type			Description	Marconi Part No. (TF..../FPP....)
Y7 Counter & Display TF 2417 (cont'd)					
Integrated circuits					
Same as Y6 (TF 2418) except as follows					
X3	C16B/R1 with RED SPOT (Gain 28-40)				28422
Y8 PARALLEL BCD INTERFACE TF 2417/4 & TF 2418/4 - TYPE 77/900 (DRG. E69/27)					
Capacitors					
C1	0.01μF	10%	250V	Polymite Film	26048
C2,3	560pF	10%		Ceramic	26034
Diodes					
D1	U2973/2				28101
Resistors					
R1	1.5k	5%	1/4W HS	Carbon	24029
R2,7	2.7k	5%	0.33W	Min. Carb. Film	24073
R3,4,10	5.6k	5%	0.33W	Min. Carb. Film	24078
R6	4.7k	5%	0.33W	Min. Carb. Film	24083
R8,12	8.2k	5%	0.33W	Min. Carb. Film	24060
R9	22k	5%	0.33W	Min. Carb. Film	24061
R11,13	27k	5%	1/4W	Min. Carb. Film	24096
R14,16,18	8.2k	5%	0.33W	Min. Carb. Film	24060
R15,17	27k	5%	1/4W	Min. Carb. Film	24096
Transistors					
TR1-3	U15718/2				28206
TR4-7	BC108				28201
Integrated Circuits					
X1-4	SN74L164N				28417
X5	SN74L73N				28418
Y9 SERIAL BCD INTERFACE TF 2417/3 & TF 2418/3 - TYPE 77/910 (DRG. E69/33)					
Resistors					
R1-4	8.2k	5%	1/4W HS	Carbon	24003
R5-8	27k	5%	1/4W HS	Carbon	24096
Transistors					
TR1-4	BC108				28201
Y10 MARKER PULSE BOARD TF 2417/3 & /4, TF 2418/3 & /4 - TYPE 7700/13 (DRG. E69/77)					
Capacitors					
C1	560pF	10%		Ceramic	26034
C2	1500pF	10%		Ceramic	26036
C3	0.01μF	10%	250V	Met. Film	26033

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Y10 MARKER PULSE BOARD TF 2417/3 & /4, TF 2418/3 & /4 (cont'd)			
Diodes			
D1	U2973/2		28101
Resistors			
R1	47k 5% 0.33W	Min. Carb. Film	24090
R2,4	1k 5% 0.33W	Min. Carb. Film	24084
R3	12k 5% 1/8W	Carb. Film	24065
Transistors			
TR1	BC108		28201
TR2	C407		28202
Y11 BASEBOARD TF 2418 (DRG. E69/55)			
Capacitors			
C1-6,10 16-18	47nF +50% -25%	Disc	26010
C7,25	56pF 5%	Ceramic	26028
C8	47nF 10%	Ceramic	26029
C9,27	15µF 16V	Elect.	26039
C11	1.5µF 63V	Elect.	26042
C12,14,15	4.7nF 10% 250V	Met. Film	26022
C13	0.1µF 10% 250V	Met. Film	26031
C19,30	1000pF 10%	Ceramic	26032
C20	47pF 5%	Ceramic	26019
C21,24	47nF +50% -25%	Disc	26010
C22	30pF	Trimmer	
C23	10pF 5%	Ceramic	26026
C26	330pF	Disc	
C28	0.22µF 10% 250V	Met. Film	26018
C29	1µF 63V	Elect.	26046
C31,33	3.3nF 20% 500V	Min. tube Poly.	26047
C32,34,35	47nF +50% -25%	Disc	26010
Diodes			
D1-23, 26-30	U2973/2		28101
D24/25, 32	1N4009		28108
D33/34	U2973/2		28101

Circuit Reference	Type			Description	Marconi Part No. (TF..../FPP....)
Y11 BASEBOARD TF 2418 (cont'd)					
Resistors					
R1,10,25	10k	5%	0.33W	Min. Carb. Film	24058
R2,6	3.9k	5%	0.33W	Min. Carb. Film	24064
R3-5, 14/15	470	5%	0.33W	Min. Carb. Film	24027
R7	1.2k	5%	0.33W	Min. Carb. Film	24086
R8,12,42	2.2k	5%	0.33W	Min. Carb. Film	24018
R9	3.3k	5%	0.33W	Min. Carb. Film	24057
R11,13	4.7k	5%	0.33W	Min. Carb. Film	24083
R16-18	10	5%	0.33W	Min. Carb. Film	24013
R19-22	12k	5%	0.33W	Min. Carb. Film	24065
R23,28	2.2k	5%	0.33W	Min. Carb. Film	24018
R24	220k	5%	0.33W	Min. Carb. Film	24016
R26,50	1k	5%	0.33W	Min. Carb. Film	24084
R27,37 39/40	100k	5%	0.33W	Min. Carb. Film	24059
R29	1.5k	5%	0.33W	Min. Carb. Film	24024
R30,31 33-36	10k	5%	0.33W	Min. Carb. Film	24058
R32,47	4.7k	5%	0.33W	Min. Carb. Film	24083
R38,41,45	3.9k	5%	0.33W	Min. Carb. Film	24064
R42,51,53 56/57	10k	5%	0.33W	Min. Carb. Film	24058
R43/44	10	5%	0.33W	Min. Carb. Film	24013
R46,95	5.6k	5%	0.33W	Min. Carb. Film	24078
R48,83,92	47	5%	0.33W	Min. Carb. Film	24025
R49	33k	5%	0.33W	Min. Carb. Film	24087
R52	82k	5%	0.33W	Min. Carb. Film	24088
R54	12	5%	0.33W	Min. Carb. Film	24089
R55	47k	5%	0.33W	Min. Carb. Film	24090
R58,67	3.3k	5%	0.33W	Min. Carb. Film	24057
R59,82	4.7k	5%	0.33W	Min. Carb. Film	24083
R60/61,96	22k	5%	0.33W	Min. Carb. Film	24061
R62,75,77	10k	5%	0.33W	Min. Carb. Film	24058
R63,65,68	8.2k	5%	0.33W	Min. Carb. Film	24060
R64,69/70 80/81	1k	5%	0.33W	Min. Carb. Film	24084
R66,79,86	6.8k	5%	0.33W	Min. Carb. Film	24082
R71,85	470	5%	0.33W	Min. Carb. Film	24027
R72-74, 99	10	5%	0.33W	Min. Carb. Film	24013
R76,78	100	5%	0.33W	Min. Carb. Film	24020
R84,94	10k	5%	0.33W	Min. Carb. Film	24058
R87,88	560	5%	0.33W	Min. Carb. Film	24091
R89,90	8.2k	5%	0.33W	Min. Carb. Film	24060
R91,100/101	3.3k	5%	0.33W	Min. Carb. Film	24057
R93	390k	5%	0.33W	Min. Carb. Film	24092
R95	5.6k	5%	0.33W	Min. Carb. Film	24078
R97,102	470	5%	0.33W	Min. Carb. Film	24027
R98	2.2k	5%	0.33W	Min. Carb. Film	24018
R103	1k	5%	0.33W	Min. Carb. Film	24084
R104	3.9k	5%	0.33W	Min. Carb. Film	24064
R105	270	5%	0.33W	Min. Carb. Film	24093
R106	4.7k	5%	0.33W	Min. Carb. Film	24083

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Y11 BASEBOARD TF 2418 (cont'd)			
Switches			
S1-4	4 push-button		23107
S5-7	3 push-button		23108
Transistors			
TR1/2	C407		28202
TR3-6, 10/11,16	U15718/2		28206
TR7	V435		28207
TR8,9, 12-15	BC108		28201
TR17	V405A		28205
Integrated Circuits			
X1,6,10	SN7400		28406
X2,3,8	SN7401		28410
X4,5	C16B/R1		28420
X7	SN7473		28409
X9	SN7413		28405
Crystals			
XL1	100kHz	Quartz	28304
Y12 BASEBOARD TF 2417 (DRG. E69/58)			
Capacitors			
Same as Y11 (TF 2418) except as follows			
C26	330pF 20%	Disc	26050
C29	0.047µF +50% -25%	Disc	26010
C35	47pF		26051
Diodes			
Same as Y11 (TF 2418) except as follows			
D31	BZY88/C6V2		28114
Resistors			
Same as Y11 (TF 2418) except as follows			
R31	6.8k 5% 0.33W	Min. Carb. Film	24082
R60,83	10 5% 0.33W	Min. Carb. Film	24013
R82	2.2k 5% 0.33W	Min. Carb. Film	24018
R84	3.3k 5% 0.33W	Min. Carb. Film	24057
R85	560 5% 0.33W	Min. Carb. Film	24091
R86	180 5% 0.33W	Min. Carb. Film	24094
R87	82 5% 0.33W	Min. Carb. Film	24095
R93	390k 5% 0.33W	Min. Carb. Film	24092
R97	470 5% 0.33W	Min. Carb. Film	24027

Circuit Reference	Type	Description	Marconi Part No. (TF..../FPP....)
Switches			
Same as Y11 (TF 2418)			
Transistors			
Same as Y11 (TF 2418) except as follows			
TR13/14	U15718/2		28206
Integrated Circuits			
X2	SN741101N		28423
X11	SN7490		28407
Crystal			
XL1	10MHz	Quartz	28305

Chapter 7

Circuit diagrams

7.1 INTRODUCTION

For ease of reference the illustrations and diagrams are presented in four groups:-

i) Diagrams and illustrations common to the TF 2417 and TF 2418 series
ii) Diagrams and illustrations common to TF 2417 series only
iii) Diagrams and illustrations common to TF 2418 series only
iv) Diagrams and illustrations common to TF 2417/3, TF 2417/4, TF 2418/3 and TF 2418/4

For each circuit diagram representing a printed circuit board the board layout diagram is illustrated on the left-hand page facing the relevant circuit diagram.

The boards are illustrated as viewed from the "non-component" side with component positions superimposed as though the board were transparent.

Where the double-sided p.c.b are used, a further illustration will show the "component side" track but void of components (unless the board carries components on both sides, in which case the components shown in this view will be mounted on the reverse side - again as though the board were transparent).

For each board the legends of pins that unite with miniature flying sockets (together with certain other reference marks) are shown in the "component side" view.

7.2 CIRCUIT DIAGRAMS AND ILLUSTRATION LIST

Diagrams and illustrations common to TF 2417 and TF 2418 series

TF 2417 & TF 2418	LAYOUT DIAGRAM	S71/47
BL7735/11 TYPE 77/022	Stop Start I/P Board REAR PANEL CIRCUIT	E69/54
BL77/230 TYPE 77/230	Power Supply Board POWER SUPPLY CIRCUIT	E69/52
BL77/331 TYPE 77/331	Pulse Shaper & Pre-Amp Board PULSE SHAPER & PRE-AMP CIRCUIT	E69/49

Diagrams and illustrations TF 2417 series only

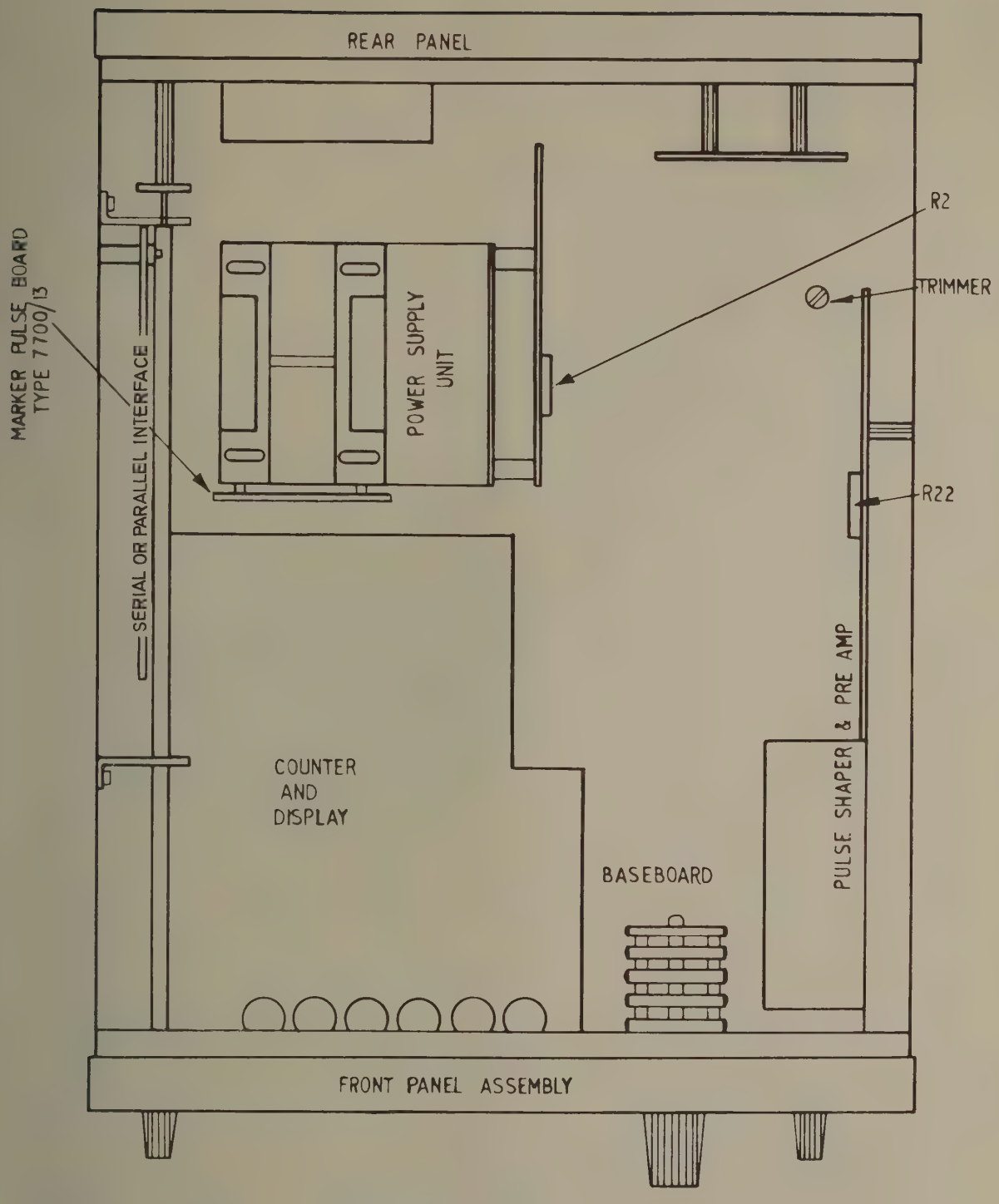
TYPE TF 2417	MAIN ASSEMBLY CIRCUIT	E69/61
TYPE 77/013	FRONT PANEL ASSEMBLY CIRCUIT	E69/59
BL7736/10 TYPE 7736/10	Baseboard BASEBOARD CIRCUIT	E69/58
BL77/750 TYPE 77/750	Counter & Display Board COUNTER & DISPLAY CIRCUIT	E69/60

Diagrams and illustrations TF 2418 series only

TYPE TF 2418	MAIN ASSEMBLY CIRCUIT	E69/56
TYPE 77/012	FRONT PANEL ASSEMBLY CIRCUIT	E69/53
BL7735/10 TYPE 7735/10	Baseboard BASEBOARD CIRCUIT	E69/55
BL77/745 TYPE 77/745	Counter & Display Board COUNTER & DISPLAY BOARD	E69/57

Diagrams and illustrations for TF 2417/3, TF 2417/4, TF 2418/3 and TF 2418/4

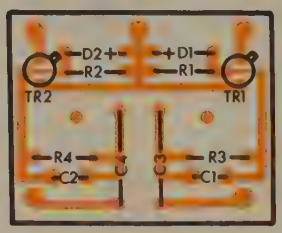
TYPE TF 2417/3	MAIN ASSEMBLY CIRCUIT	E70/10
TYPE TF 2417/4	MAIN ASSEMBLY CIRCUIT	E70/13
TYPE TF 2418/3	MAIN ASSEMBLY CIRCUIT	E70/09
TYPE TF 2418/4	MAIN ASSEMBLY CIRCUIT	E70/12
BL7700/13 TYPE 7700/13	Marker Pulse Board MARKER PULSE DIAGRAM	E69/77
BL77/910 TYPE 77/910	Serial B.C.D. Interface Board SERIAL B.C.D. INTERFACE CIRCUIT	E69/33
BL77/900 TYPE 77/900	Parallel B.C.D. Interface Board PARALLEL B.C.D. INTERFACE CIRCUIT	E69/27



NOTE:- NOT TO SCALE
ONLY THE MAIN
ITEMS ARE SHOWN.

Marconi Instruments Ltd.
TF 2417 & TF2418 Series

DIGITAL COUNTER
LAYOUT DIAGRAM
TF2417 & TF2418 SERIES
Drg. No. S71/47 ISSUE A



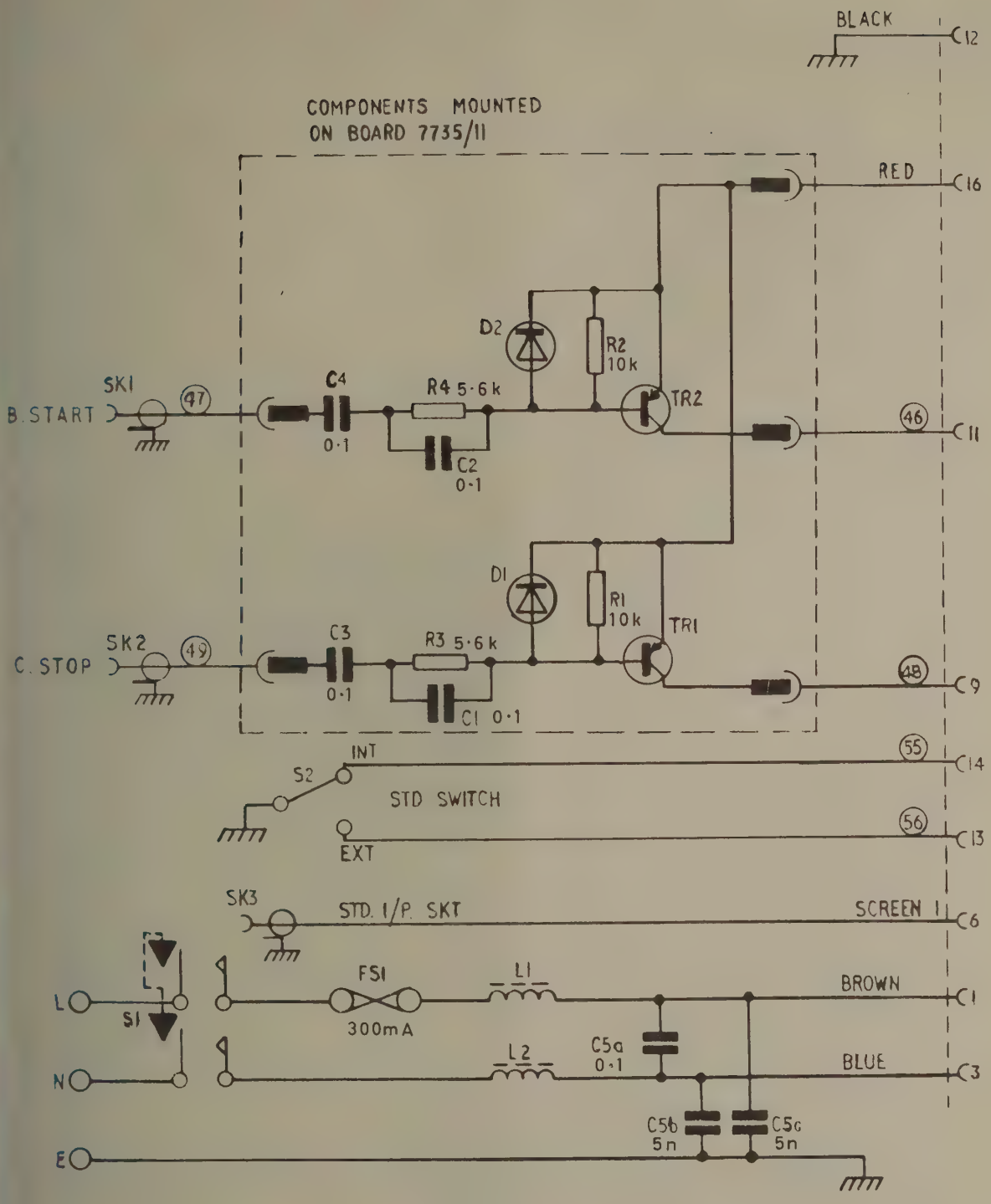
VIEWED FROM NON-COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

REF.
M2839

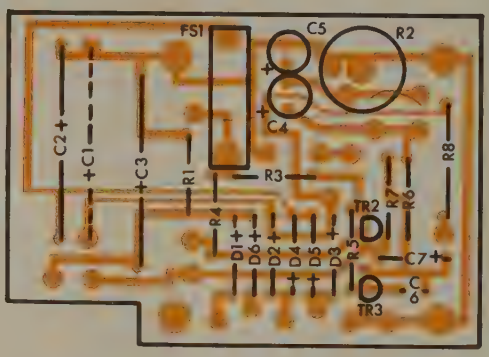
STOP & START I/P BOARD
TYPE 7735/11

BL
7735/11



REAR PANEL
CIRCUIT DIAGRAM
TYPE 77/022
Drg. No. E69/54 ISSUE C

Marconi Instrument Ltd.
TF2417 & TF2418 Series



VIEWED FROM NON-COMPONENT SIDE.

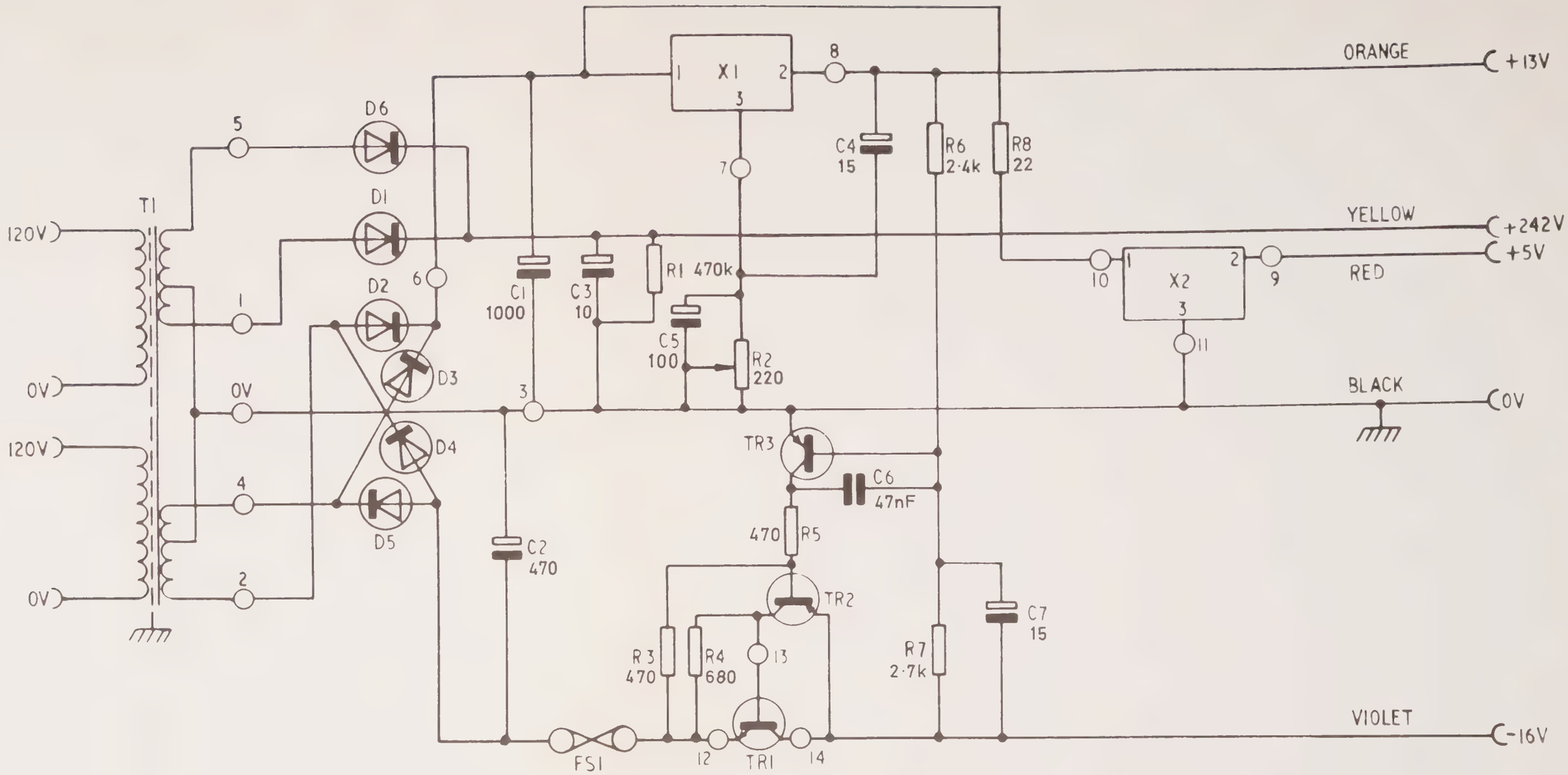
SCALE 3/4 FULL SIZE.

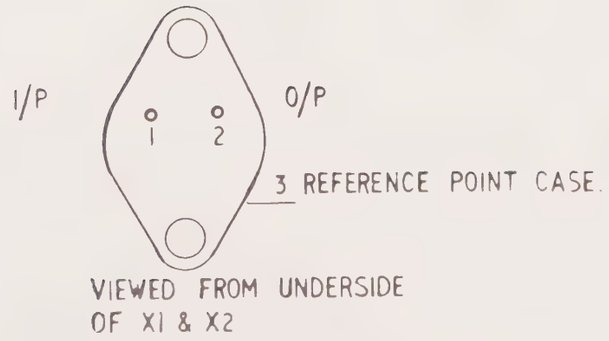
REF.
M2809

POWER SUPPLY

TYPE 77/230

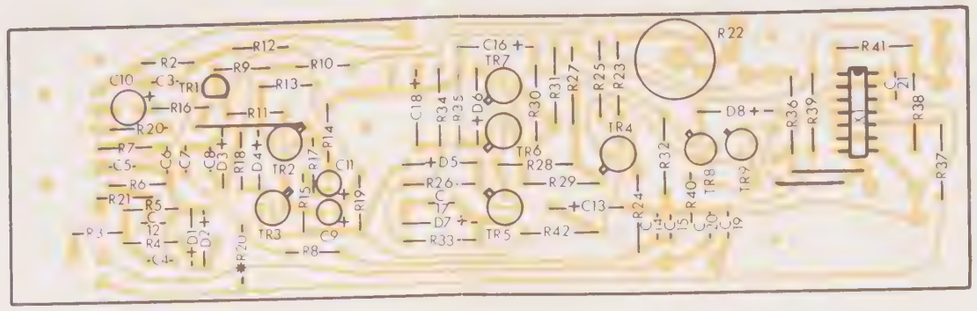
BL
77/230





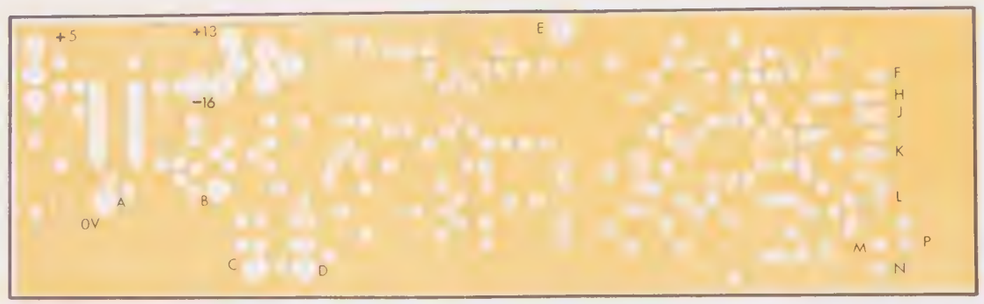
Marconi Instruments Ltd. TF2417 & TF2418 Series

POWER SUPPLY
CIRCUIT DIAGRAM
TYPE 77/230
Drg. No. E69/52 ISSUE D



VIEWED FROM NON-COMPONENT SIDE.

*R20 ALTERNATIVE POSITION USED ONLY ON INSTRUMENTS TYPE 1000F.



VIEWED FROM COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

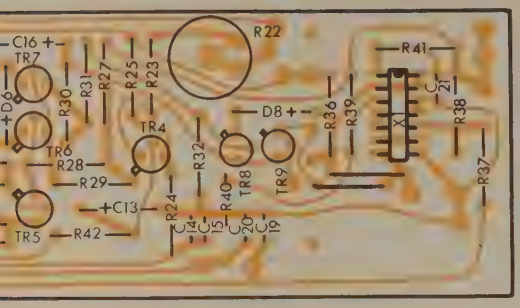
NOTE: FOR DIFFERENCES IN BOARD TYPES REFER TO CIRCUIT DIAGRAM.

REF.
M2807
M2882

PULSE SHAPER & PRE-AMP

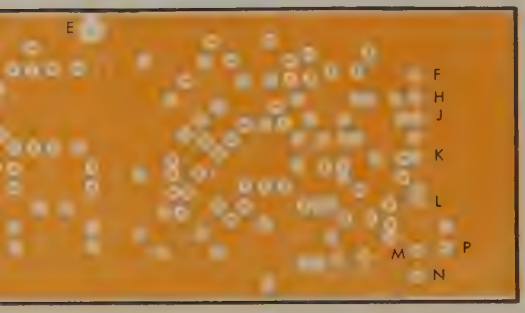
TYPE 77/330 - 77/333

BL
77/330 -
77/333



-COMPONENT SIDE.

SITION USED ONLY
PE 1000F.



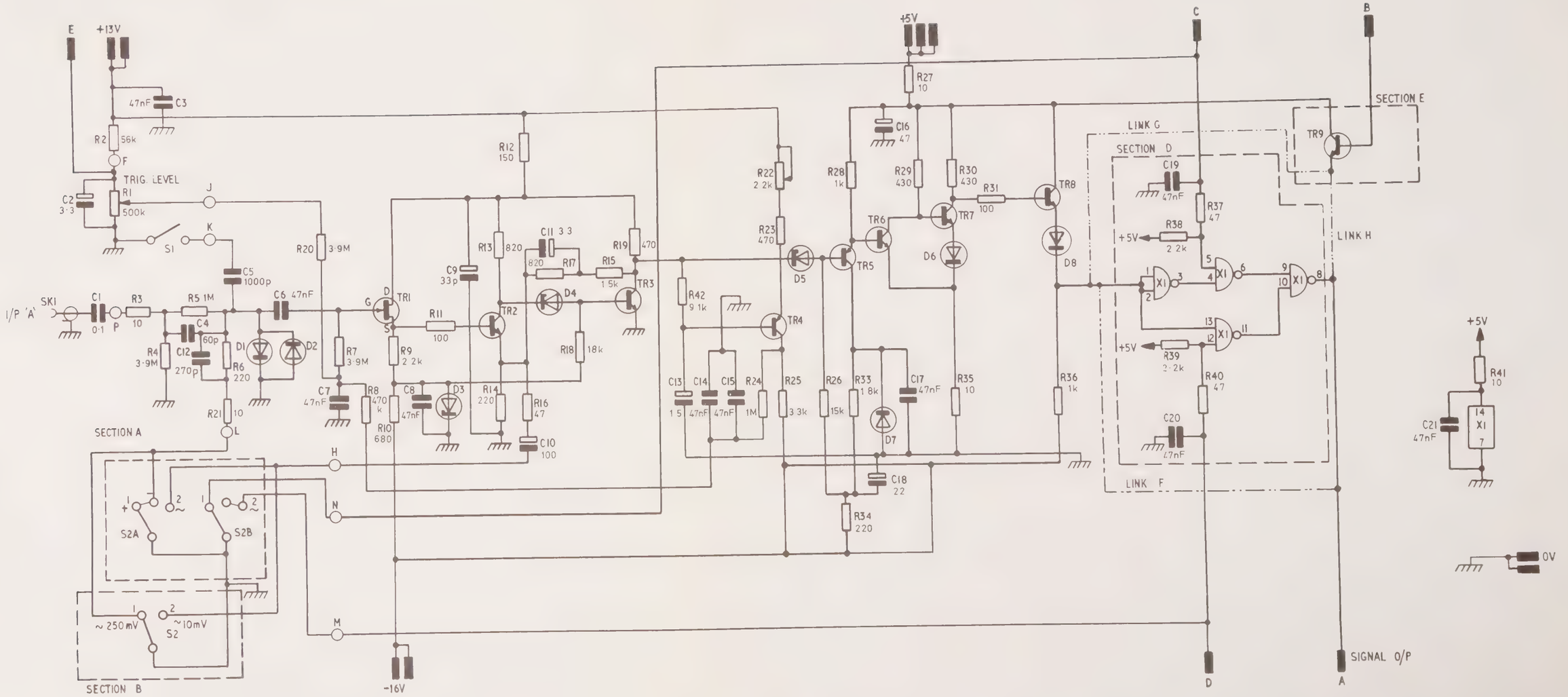
COMPONENT SIDE.

TYPES REFER TO CIRCUIT DIAGRAM.

ER & PRE-AMP

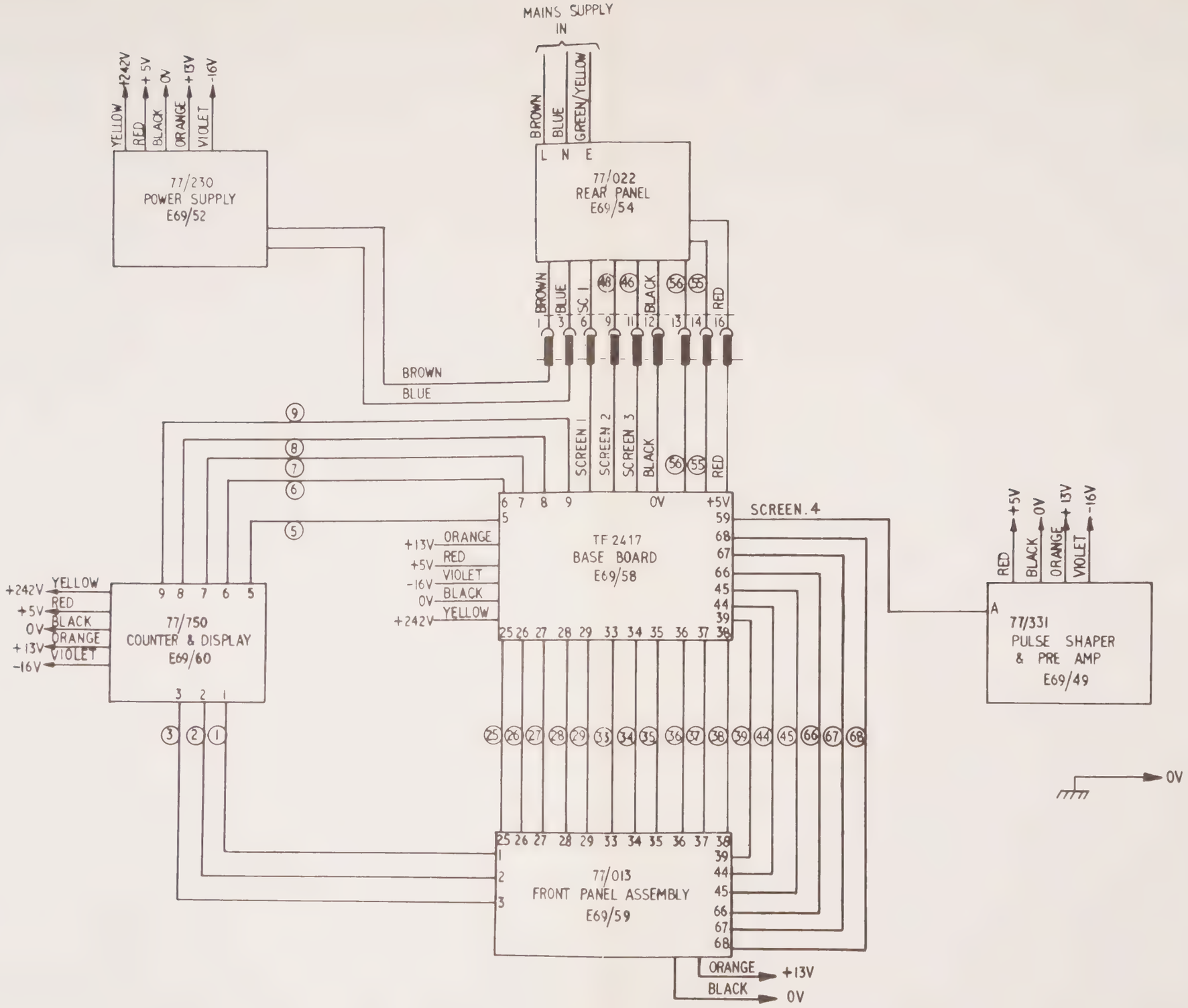
30 - 77/333

BL
77/330 -
77/333



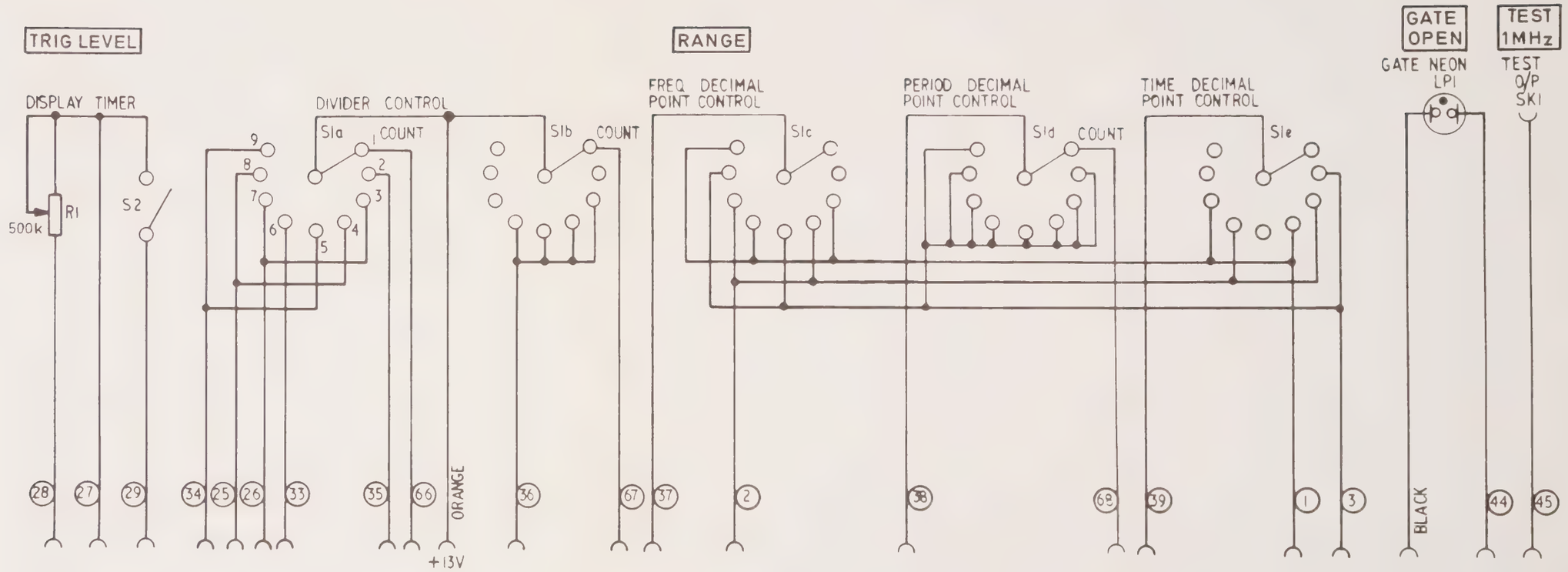
TYPE 77/331 " " " A,C,D,E & LINKS G & H ARE NOT FITTED.

PULSE SHAPER & PRE AMP
CIRCUIT DIAGRAM
TYPE 77/331
Drg. No. E69/49



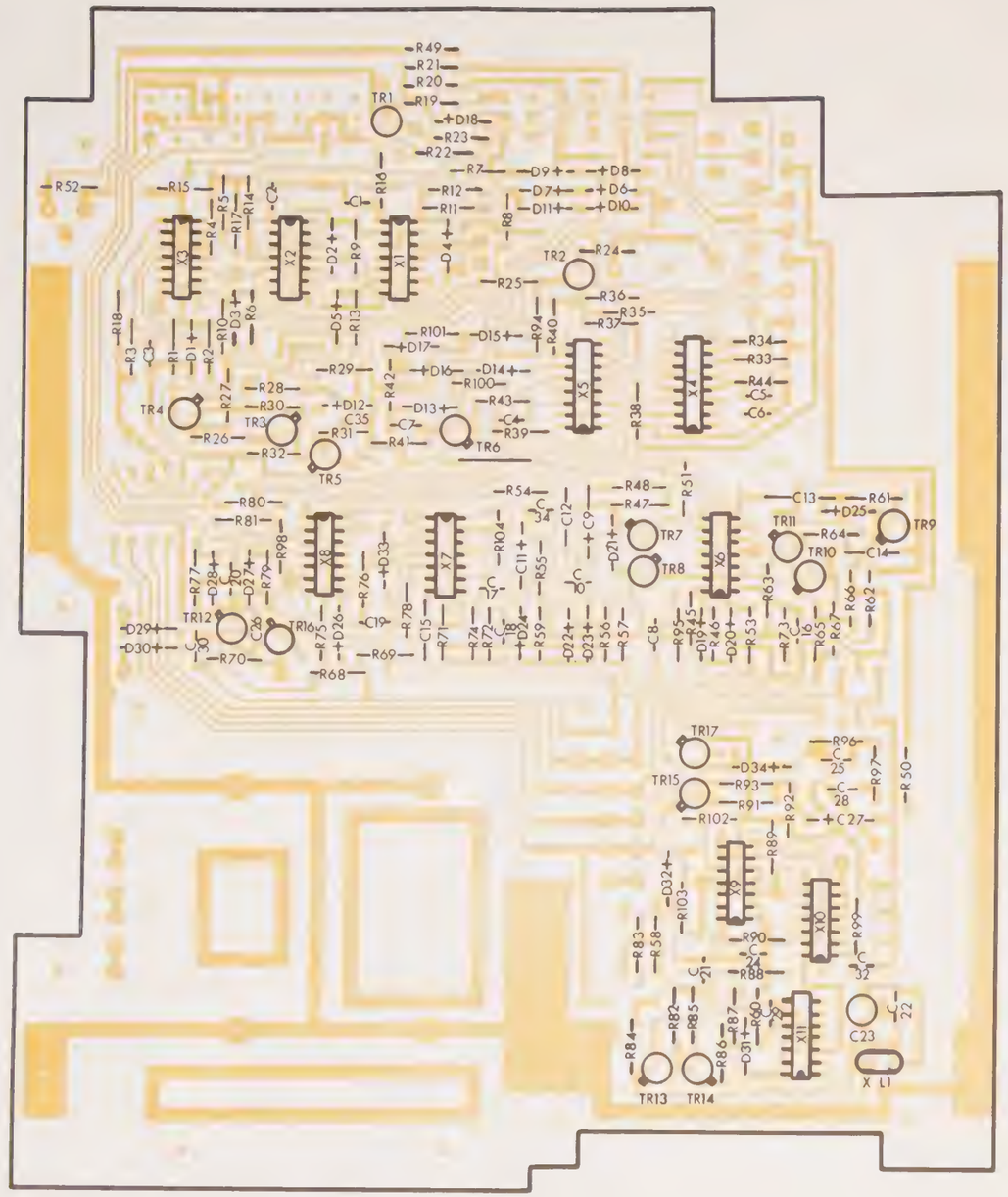
Marconi Instruments Ltd. TF 2417 Series

MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF2417
Drg. No. E69/61 ISSUE C

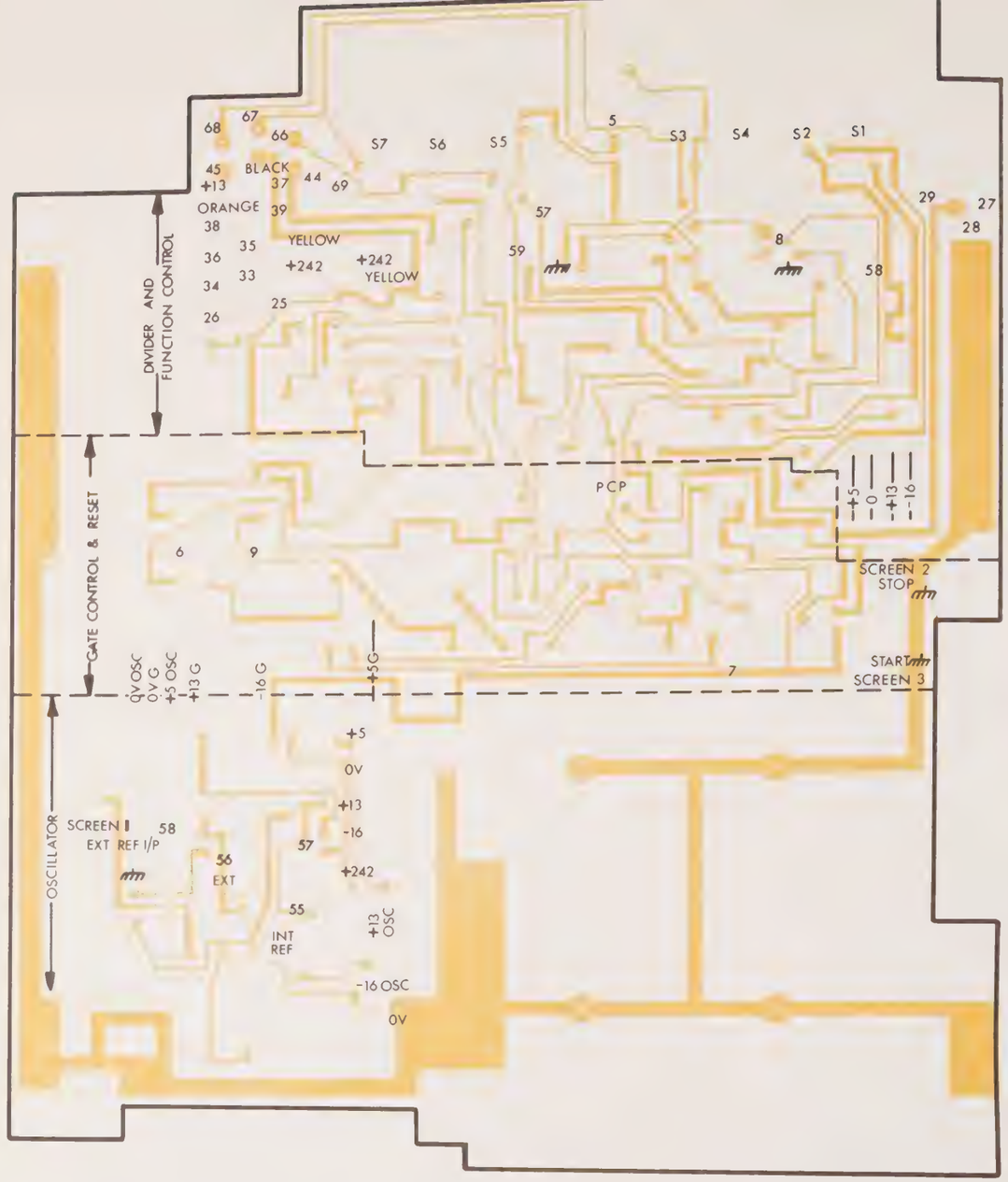


Marconi Instruments Ltd. TF2417 Series

FRONT PANEL ASSEMBLY
CIRCUIT DIAGRAM
TYPE 77/013
Drg. No. E69/59 ISSUE A



VIEWED FROM NON-COMPONENT SIDE.



VIEWED FROM COMPONENT SIDE.

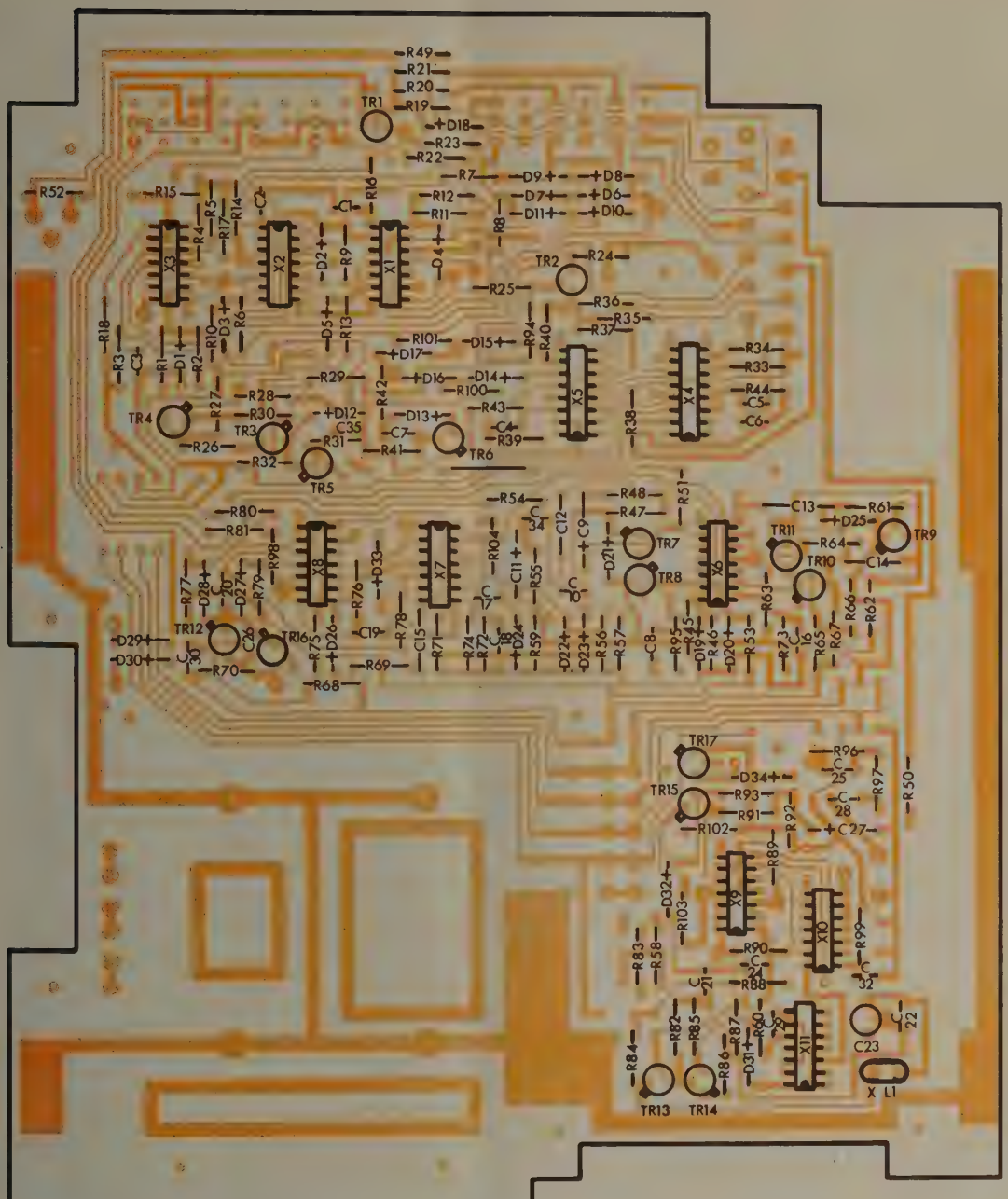
SCALE 3/4 FULL SIZE

REF.
M2949
M2950

BASE BOARD

TYPE 7736/10

BL
7736/10



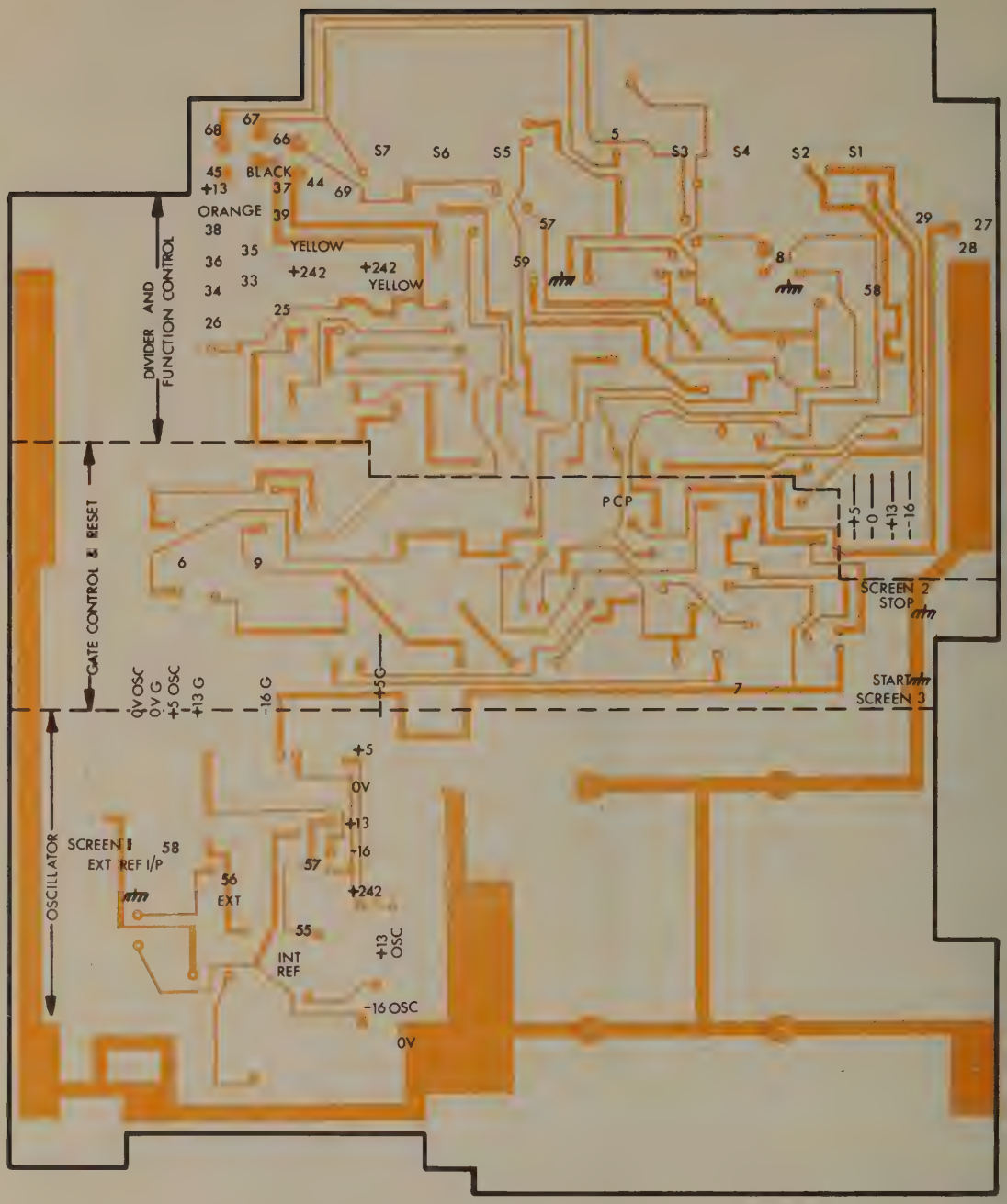
VIEWED FROM NON-COMPONENT SIDE.

SCALE 3/4 FULL SIZE

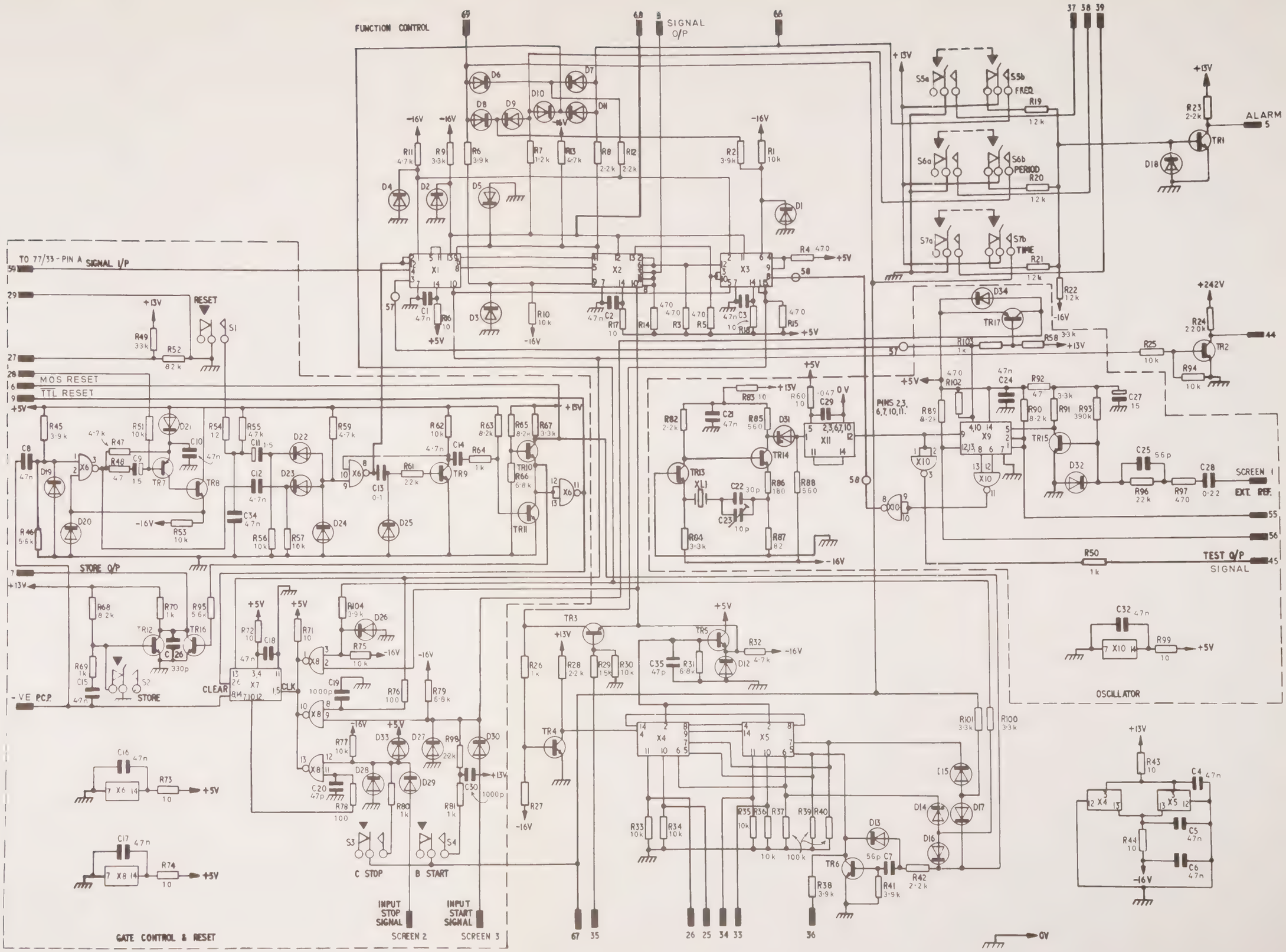
REF.
M2949
M2950

BASE B

TYPE 77

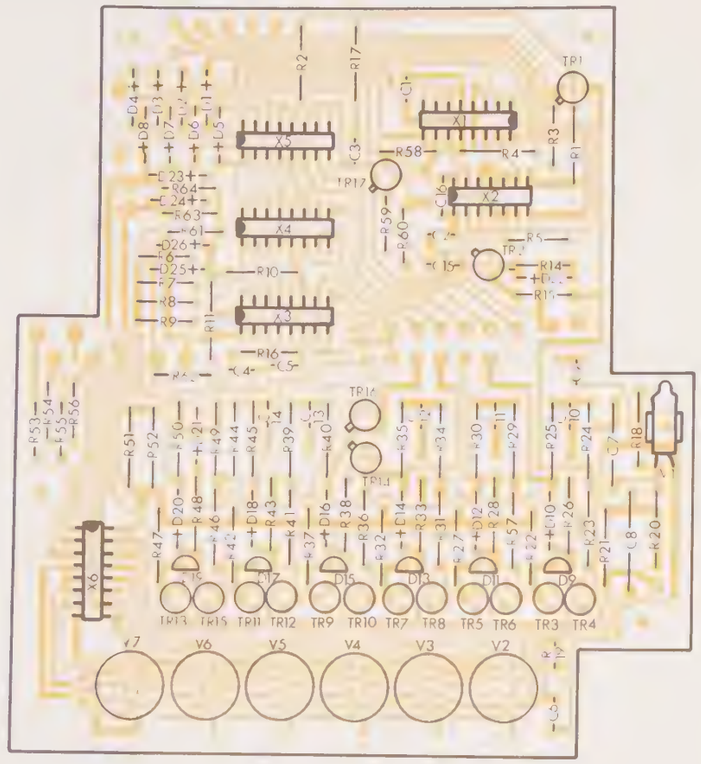


VIEWED FROM COMPONENT SIDE.

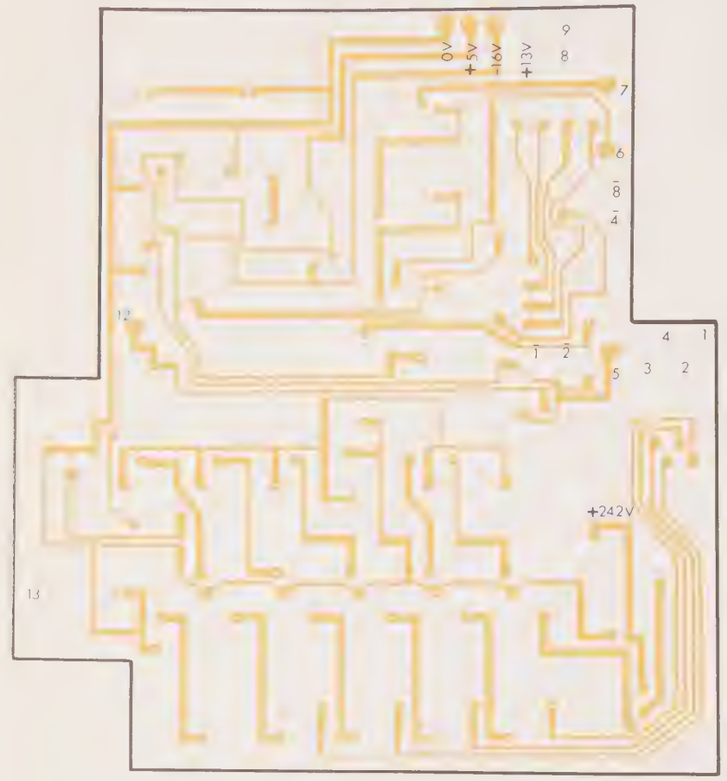


Marconi Instruments Ltd. TF2417 Series

BASEBOARD
CIRCUIT DIAGRAM
TYPE TF2417
Drg. No. E69/58 ISSUE F



VIEWED FROM NON-COMPONENT SIDE.



VIEWED FROM COMPONENT SIDE.

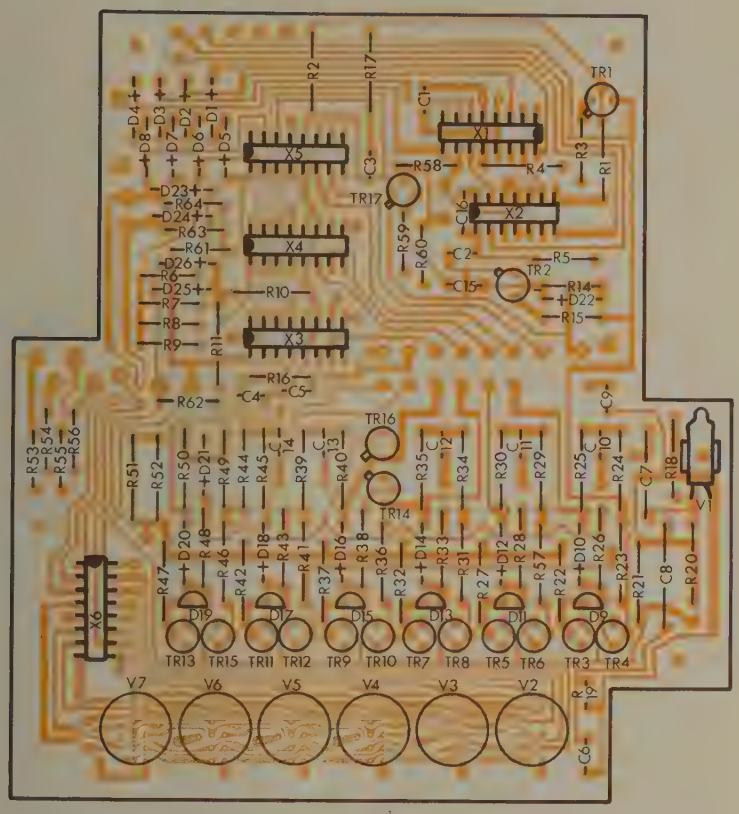
SCALE 3/4 FULL SIZE.

REF.
M2945
M2946

COUNTER & DISPLAY

TYPE 77/750

BL
77/750



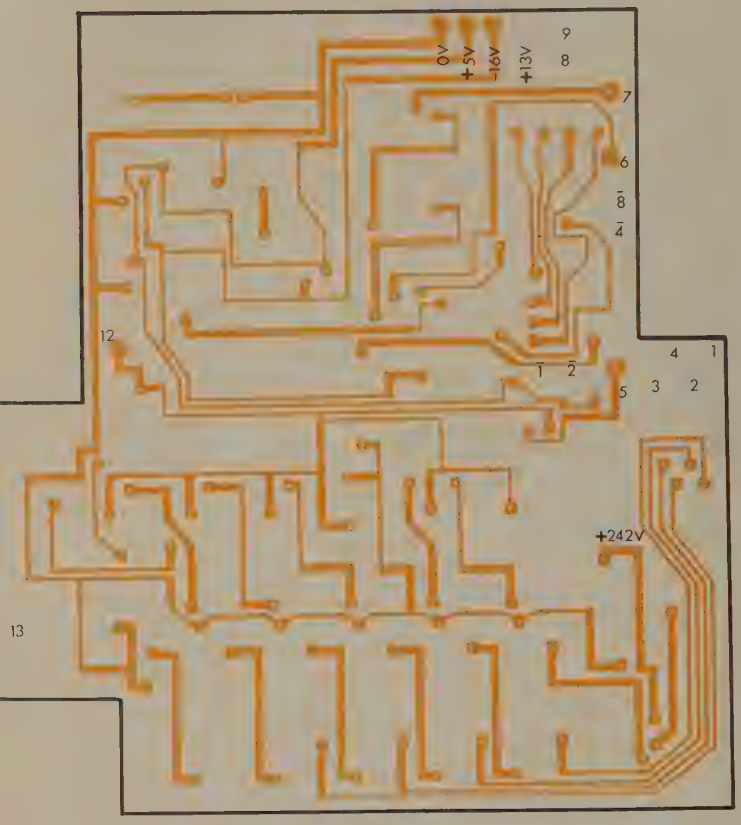
VIEWED FROM NON-COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

REF.
M2945
M2946

COUNTER &

TYPE 77/

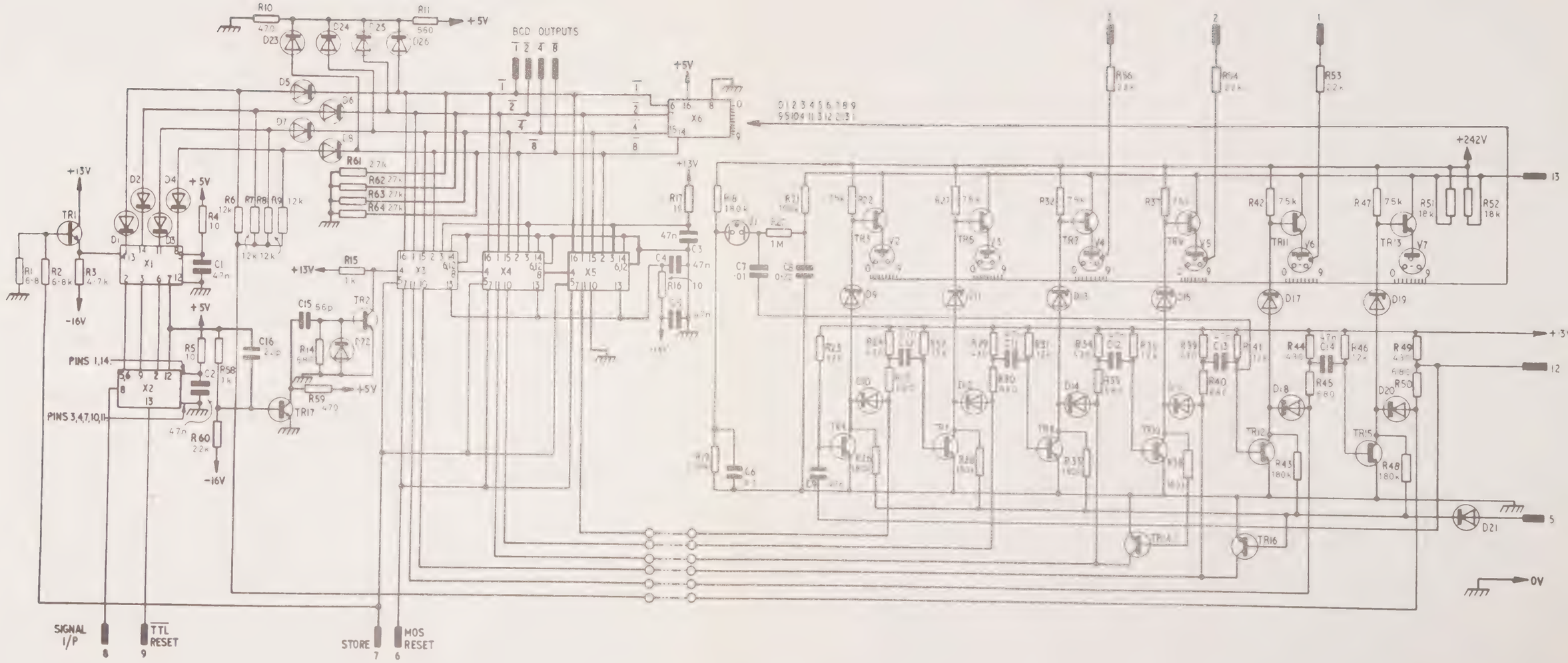


VIEWED FROM COMPONENT SIDE.

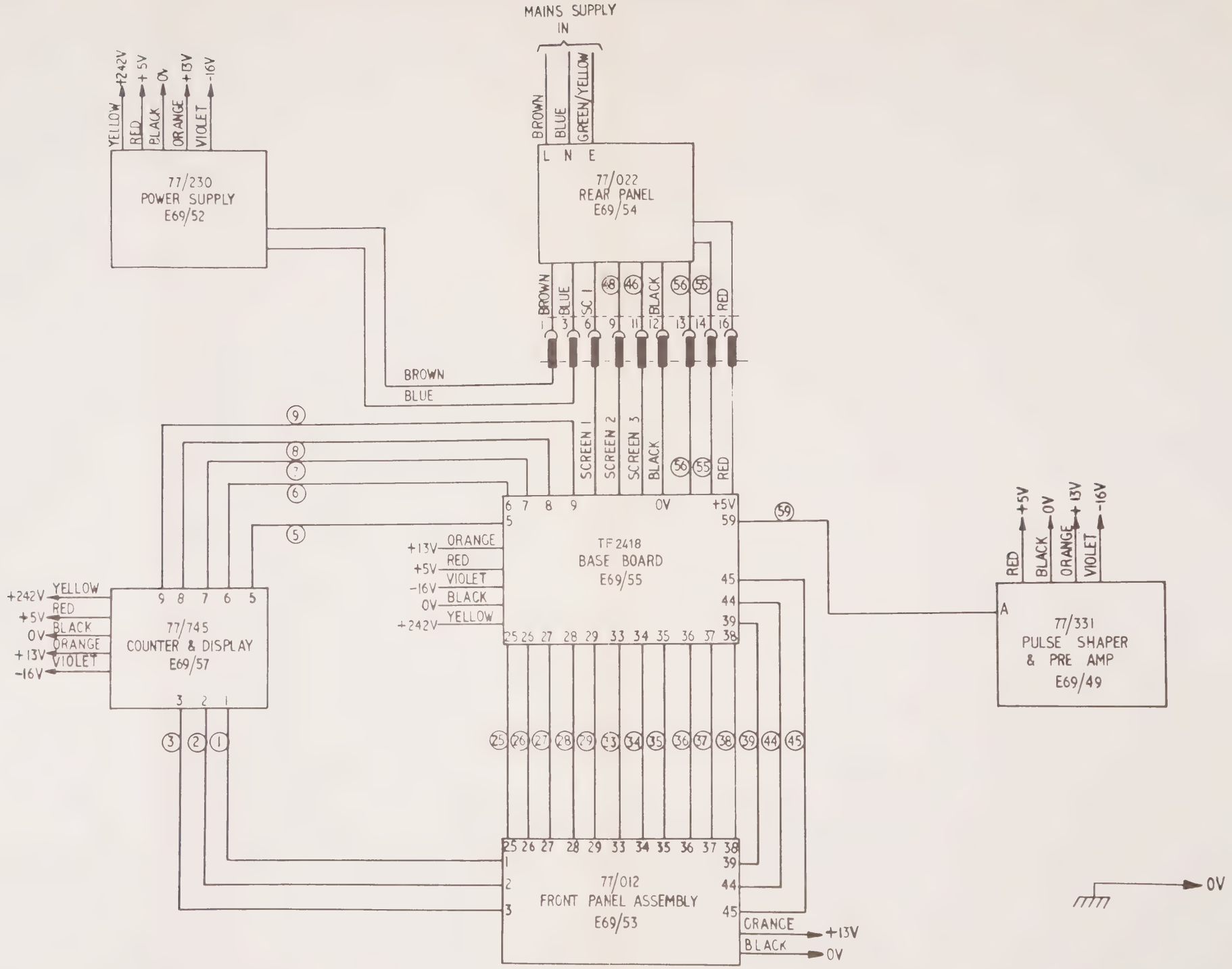
DISPLAY

50

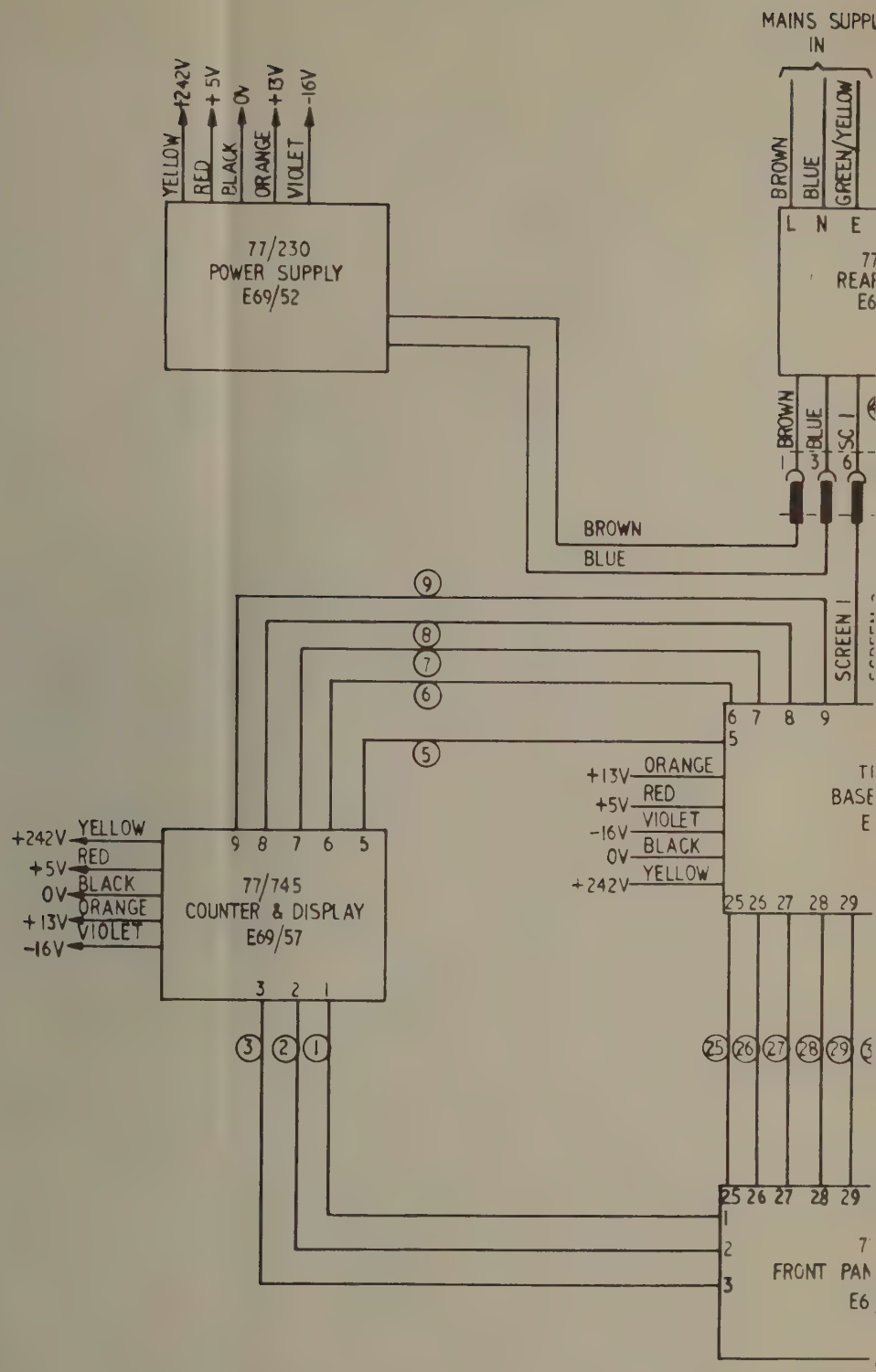
BL
77/750

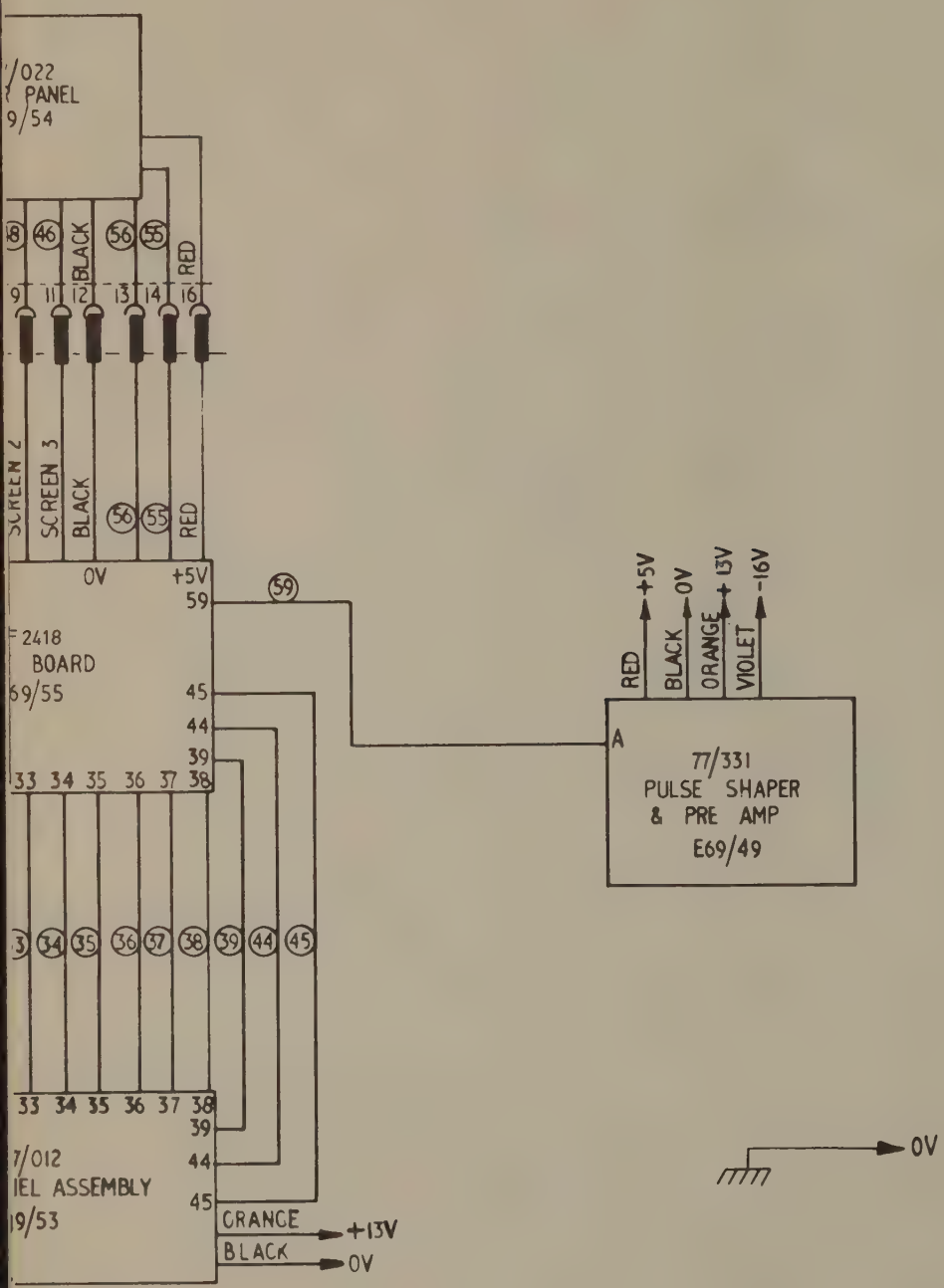


COUNTER & DISPLAY
CIRCUIT DIAGRAM
TYPE 77/750
Drg. No. E69/60 ISSUE A

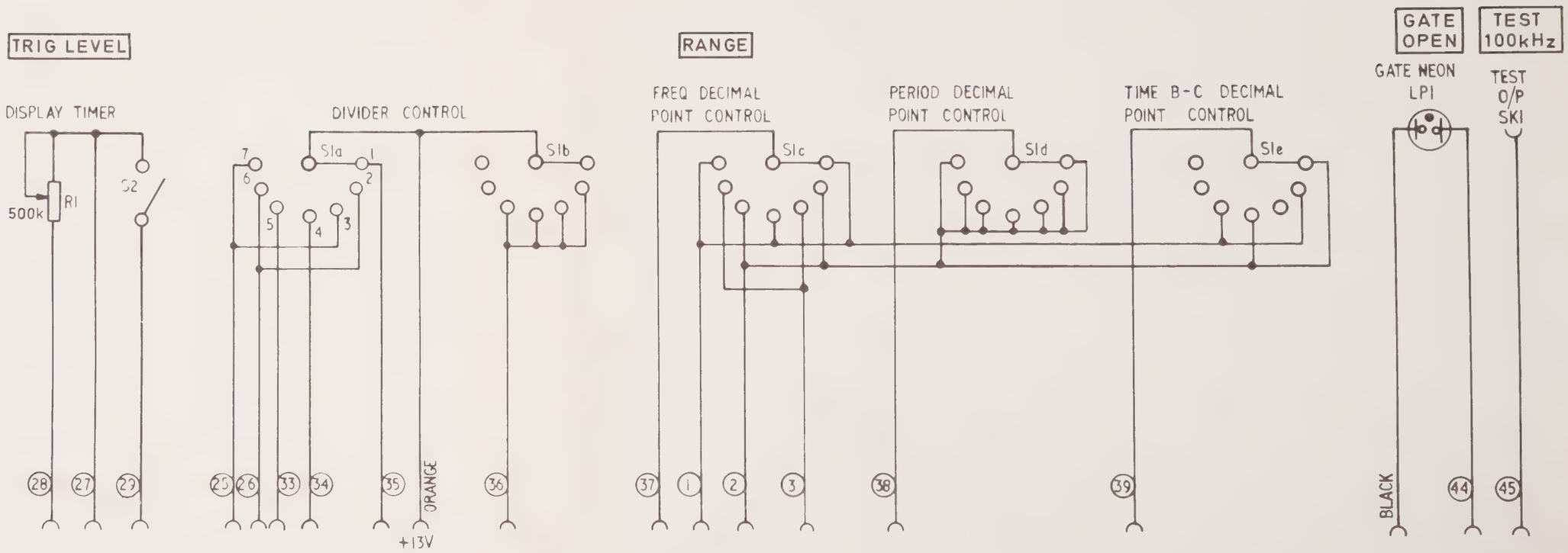


MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2418
Drg. No. E69/56 ISSUE C


MAINS SUPPL
IN
BROWN
BLUE
GREEN/YELLOW
L N E
YELLOW +242V
RED +5V
BLACK 0V
ORANGE +13V
VIOLET -16V
77/230
POWER SUPPLY
E69/52
BROWN
BLUE
SC 1
BROWN
BLUE
SCREEN 1
9
8
7
6
5
6 7 8 9
5
+13V ORANGE
+5V RED
-16V VIOLET
0V BLACK
+242V YELLOW
+242V YELLOW
+5V RED
0V BLACK
+13V ORANGE
-16V VIOLET
9 8 7 6 5
77/745
COUNTER & DISPLAY
E69/57
3 2 1
25 26 27 28 29
25 26 27 28 29
1
2
3
FRONT PAN
E6

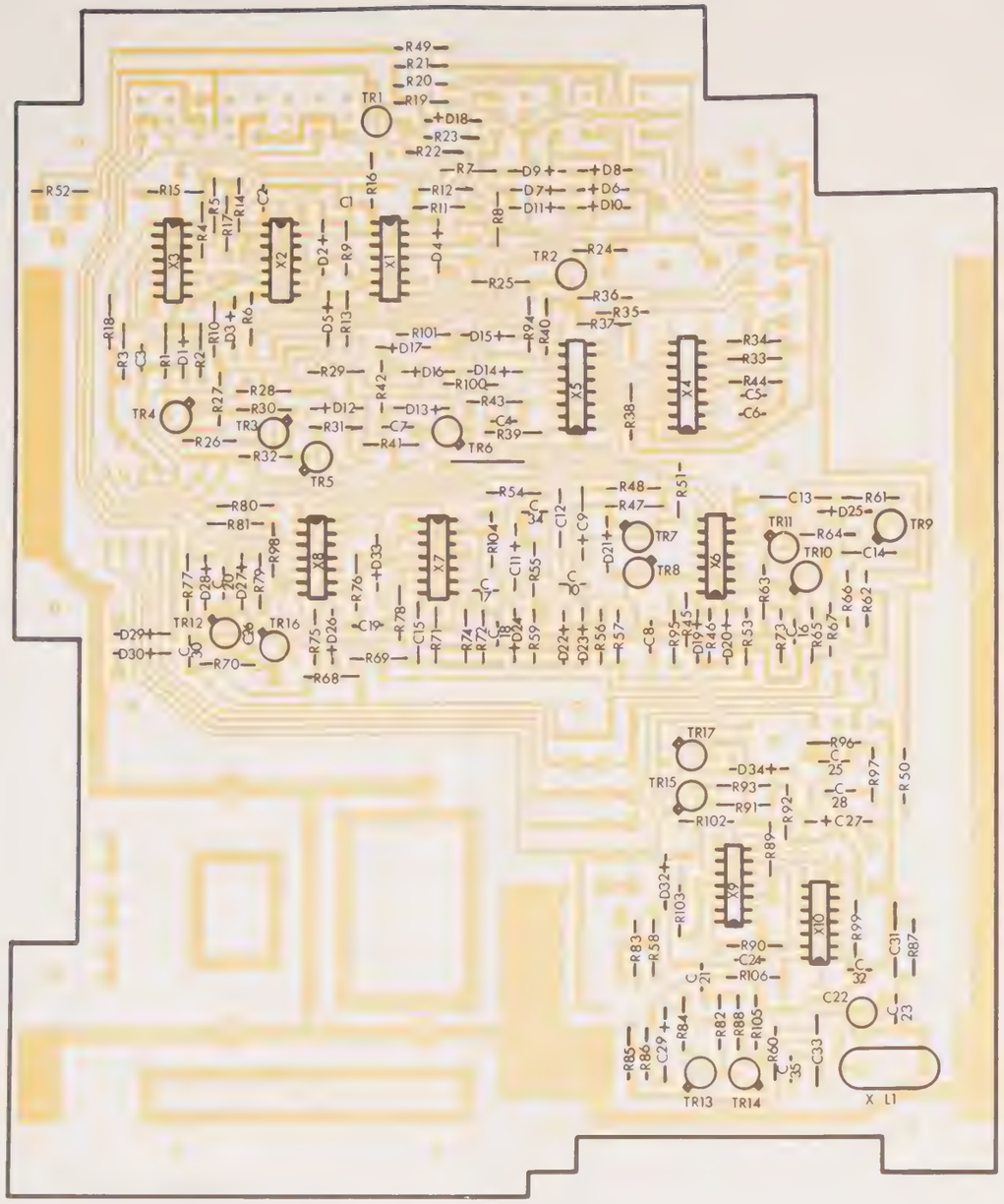


MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2418
Drg. No. E69/56 ISSUE C

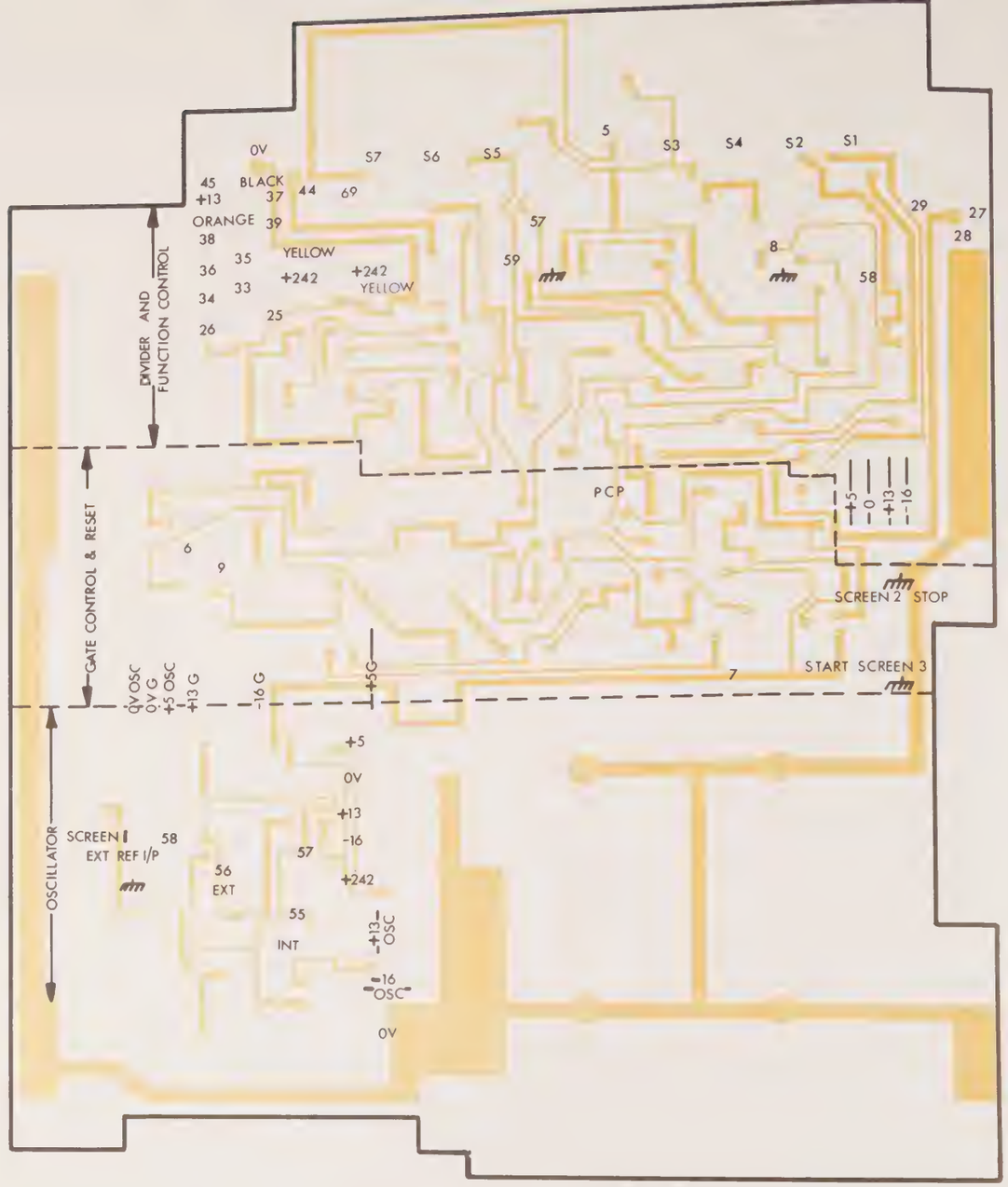


Marconi Instruments Ltd. TF 2418 Series

FRONT PANEL ASSEMBLY
CIRCUIT DIAGRAM
TYPE 77/012
Drg. No. E69/53



VIEWED FROM NON-COMPONENT SIDE.



VIEWED FROM COMPONENT SIDE.

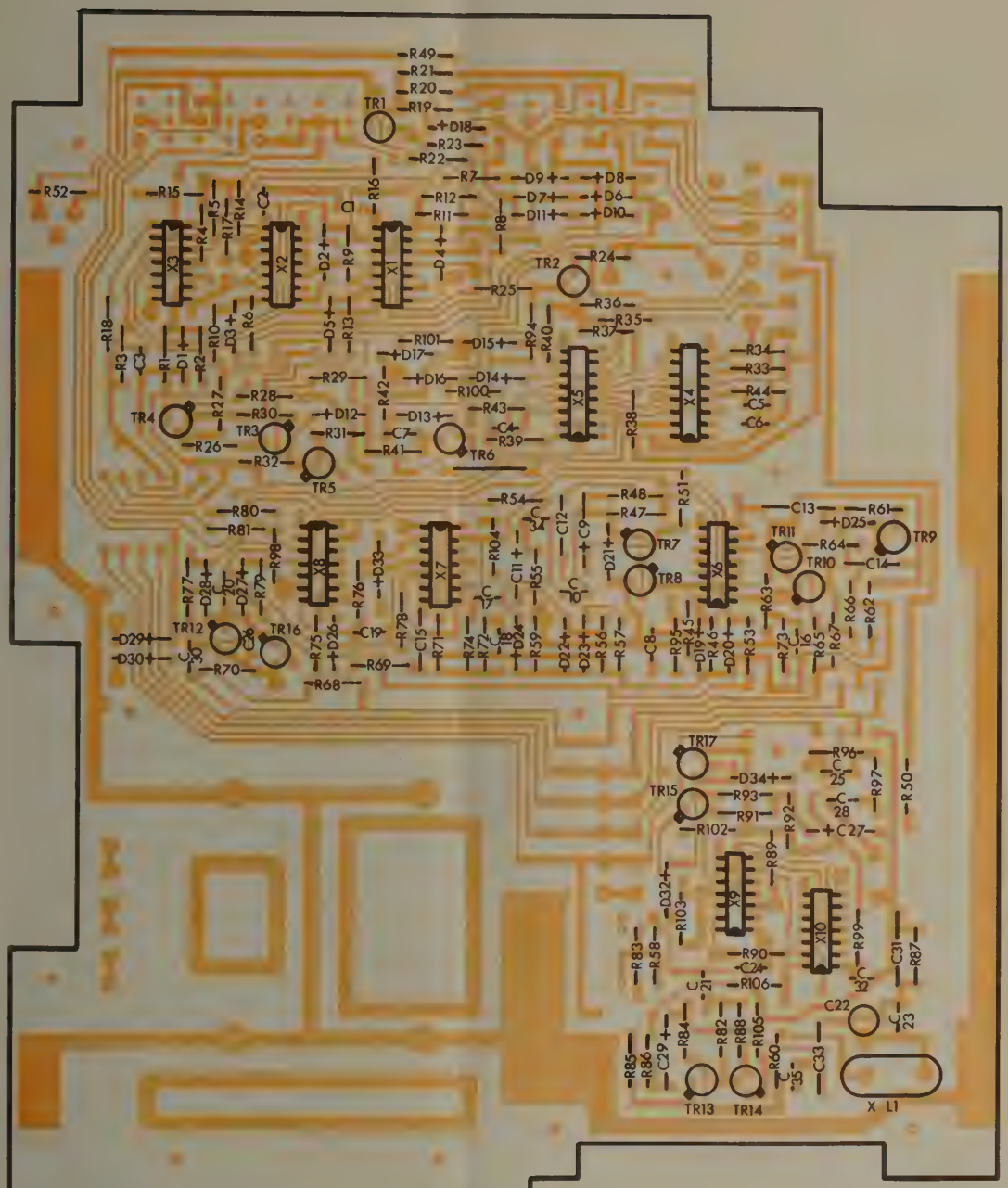
SCALE 3/4 FULL SIZE

REF.
M2805
M2806

BASE BOARD

TYPE 7735/10

BL
7735/10



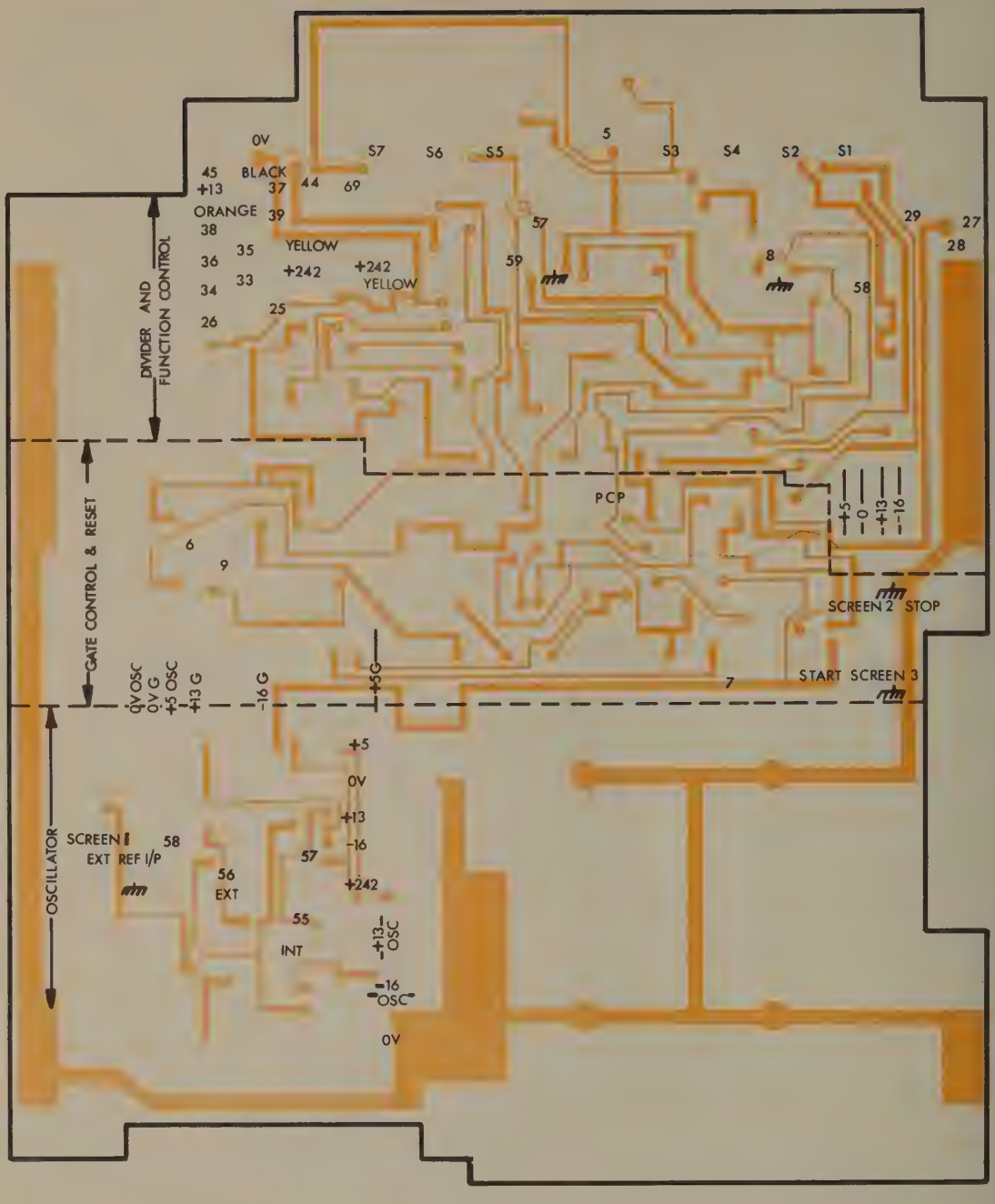
VIEWED FROM NON-COMPONENT SIDE.

SCALE 3/4 FULL SIZE

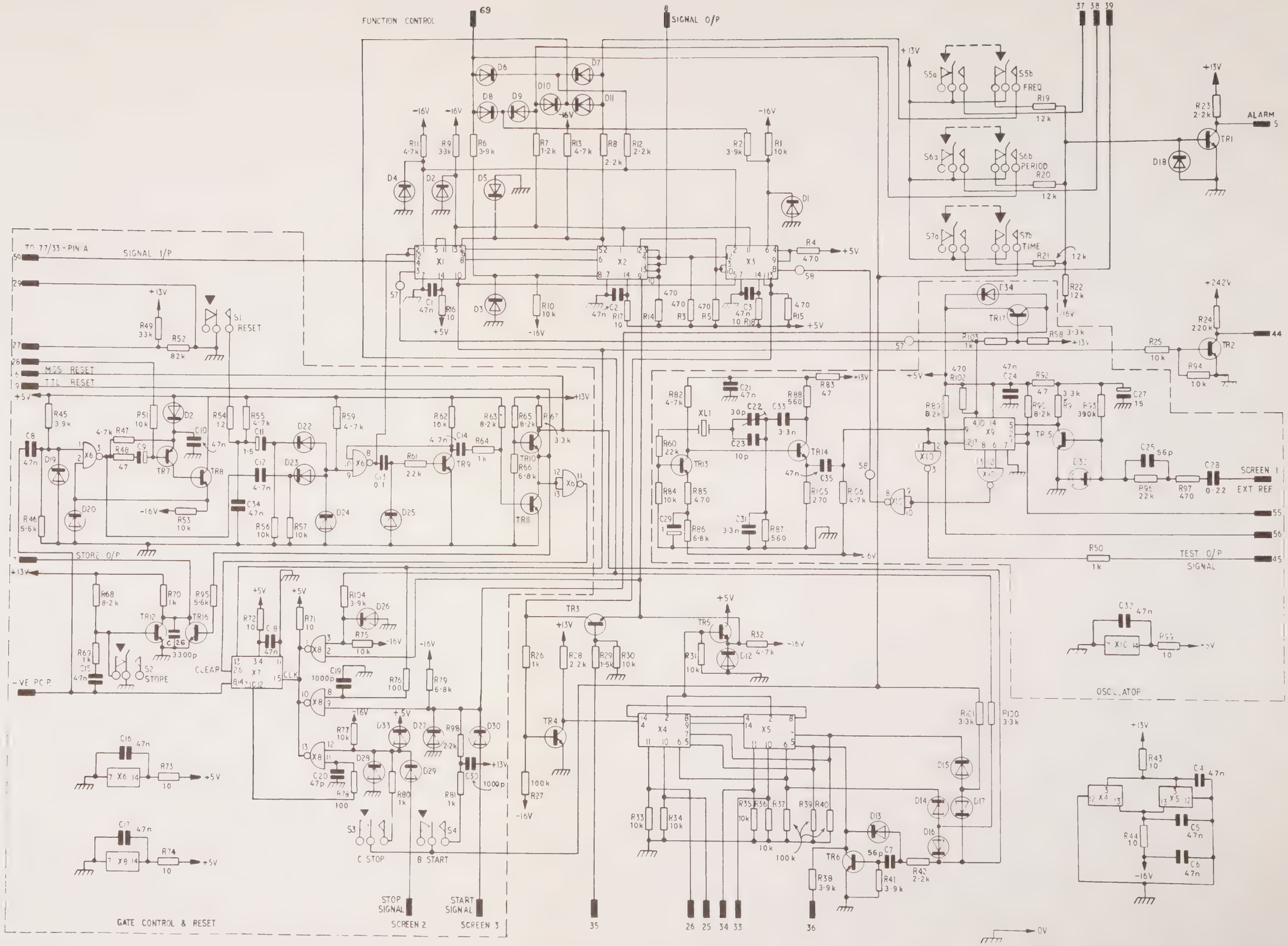
REF.
M2805
M2806

BASE B

TYPE 7

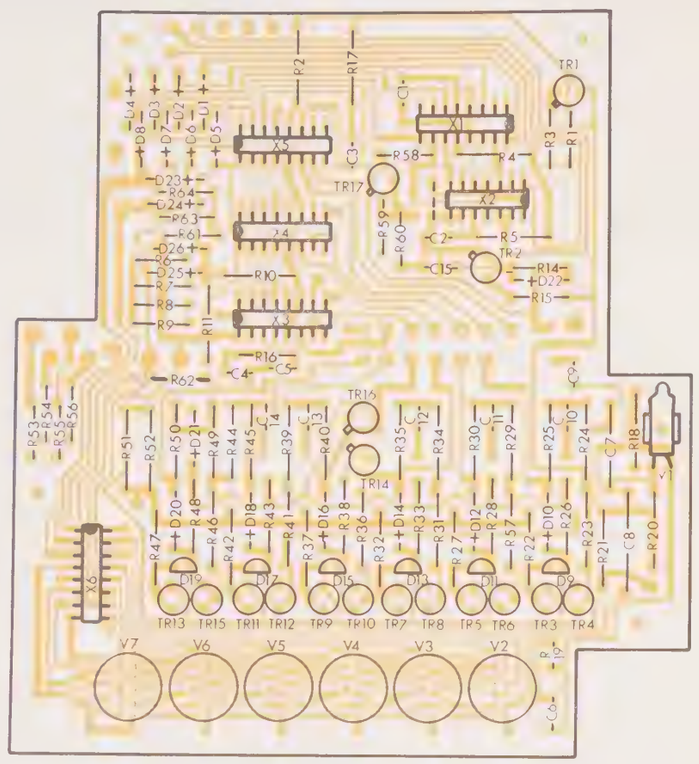


VIEWED FROM COMPONENT SIDE.

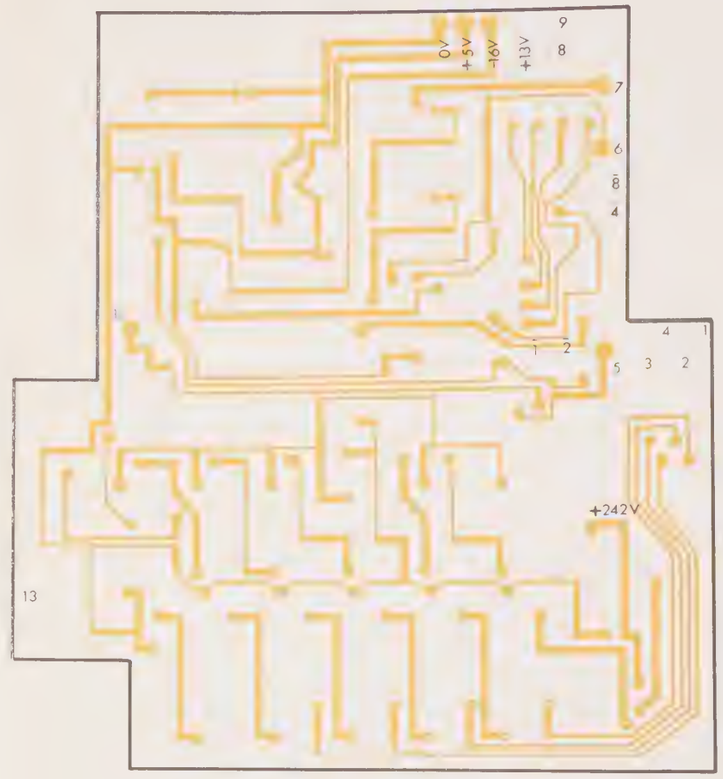


Marconi Instruments Ltd. TF2418 Series

BASEBOARD
CIRCUIT DIAGRAM
TYPE TF2418
Drg. No.E69/55 ISSUE F



VIEWED FROM NON-COMPONENT SIDE.



VIEWED FROM COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

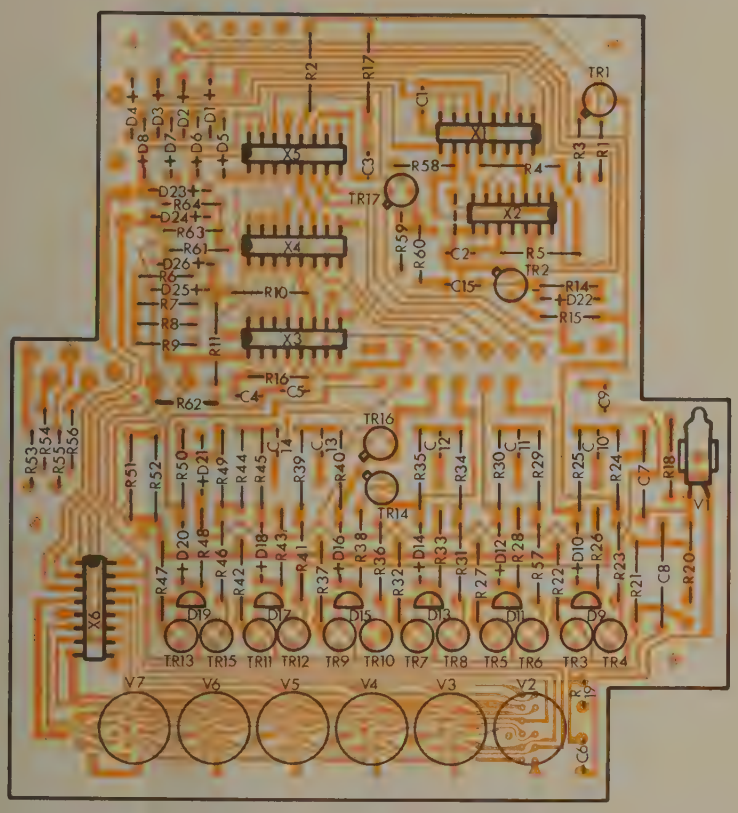
NOTE: FOR DIFFERENCES IN BOARD TYPES REFER TO CIRCUIT DIAGRAM.

REF.
M2801
M2802

COUNTER & DISPLAY

TYPE 77/745 & 77/747

BL
77/745 & 77/747



VIEWED FROM NON-COMPONENT SIDE.

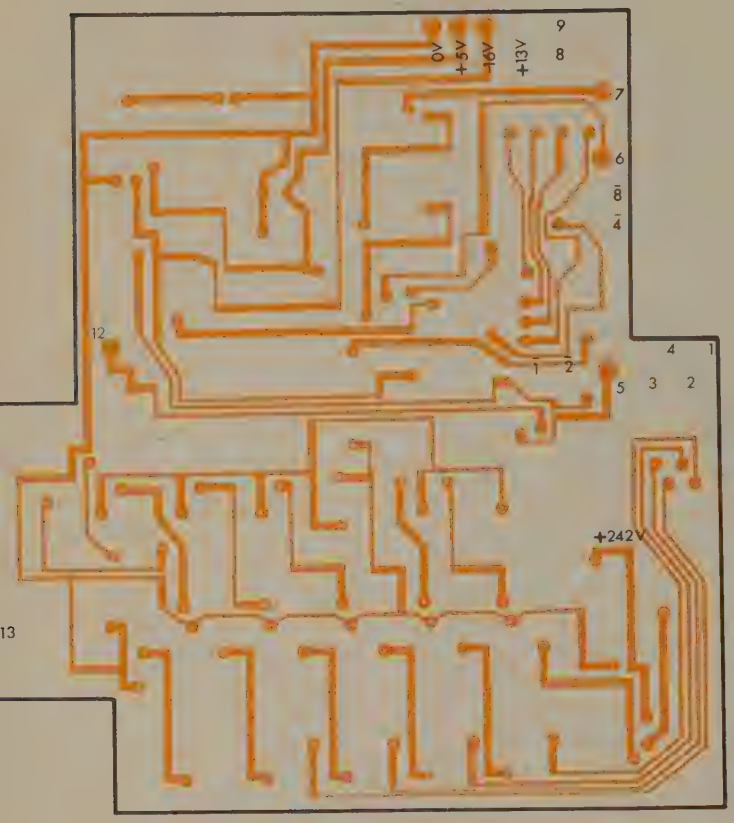
SCALE 3/4 FULL SIZE.

NOTE: FOR DIFFERENCES IN BOARD TYPES REFE

REF.
M2801
M2802

COUNTER & D

TYPE 77/745 &



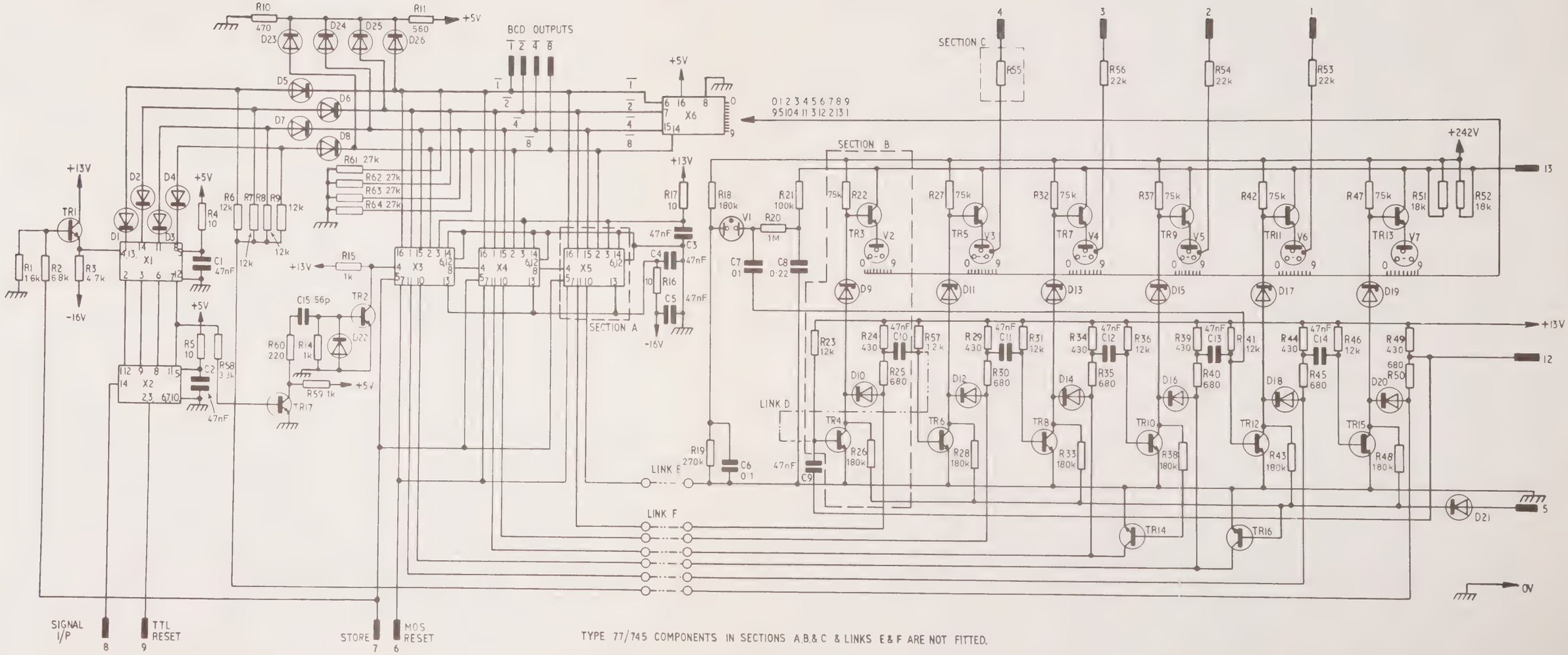
VIEWED FROM COMPONENT SIDE.

TO CIRCUIT DIAGRAM.

ISPLAY

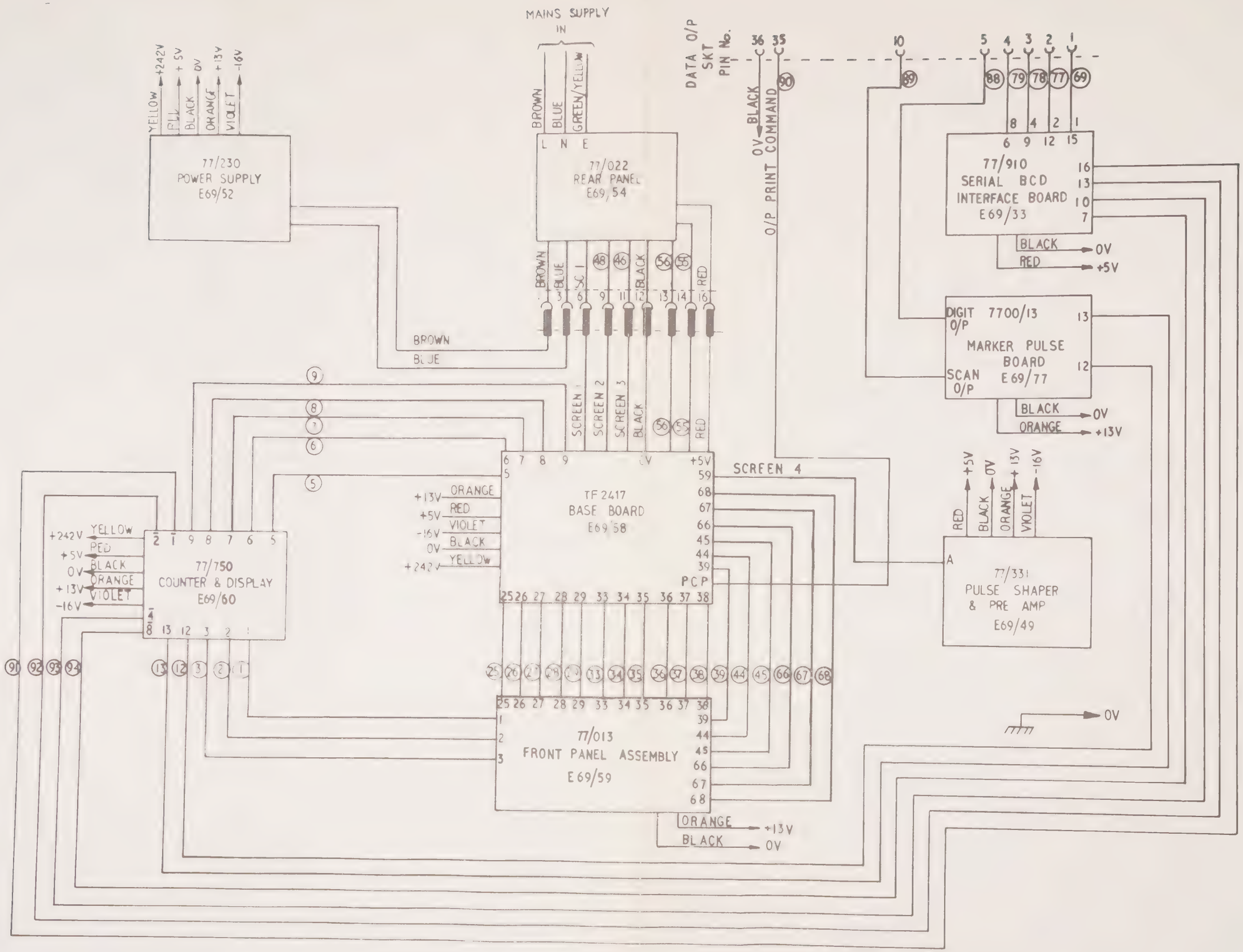
77/747

BL
77/745 &
77/747



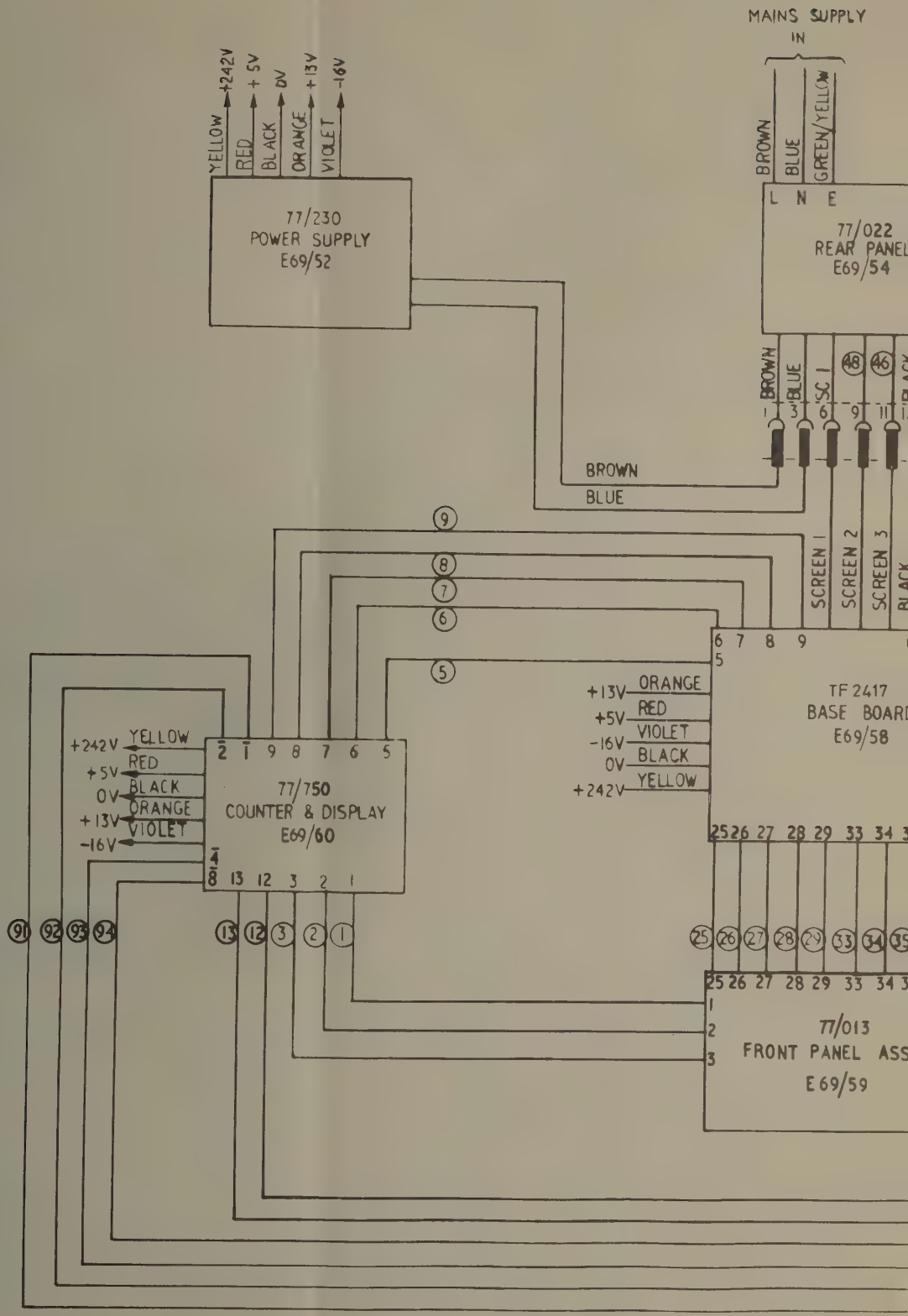
TYPE 77/745 COMPONENTS IN SECTIONS A,B,& C & LINKS E & F ARE NOT FITTED.

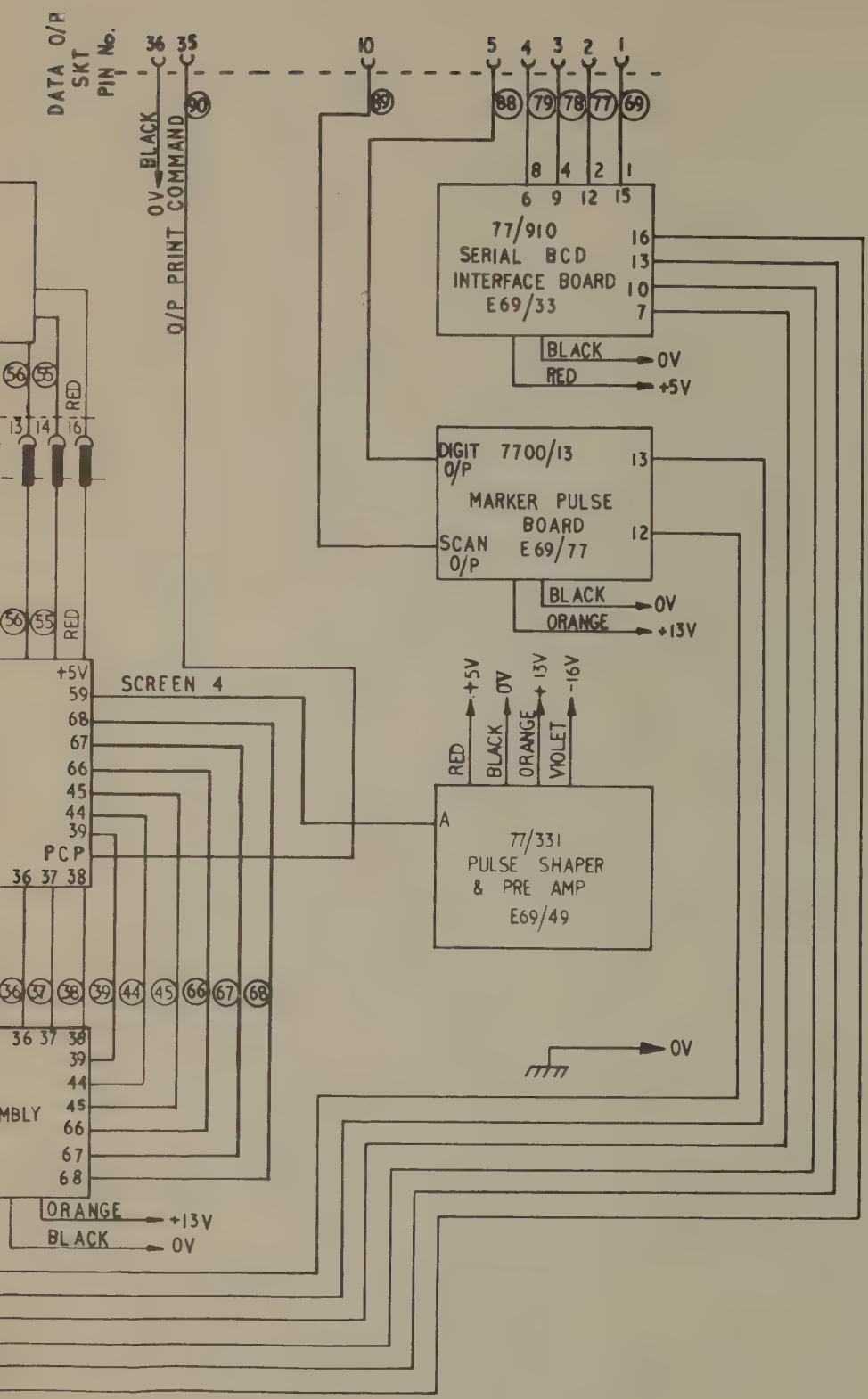
COUNTER & DISPLAY
CIRCUIT DIAGRAM
TYPE 77/745
Drg. No. E69/57 ISSUE B



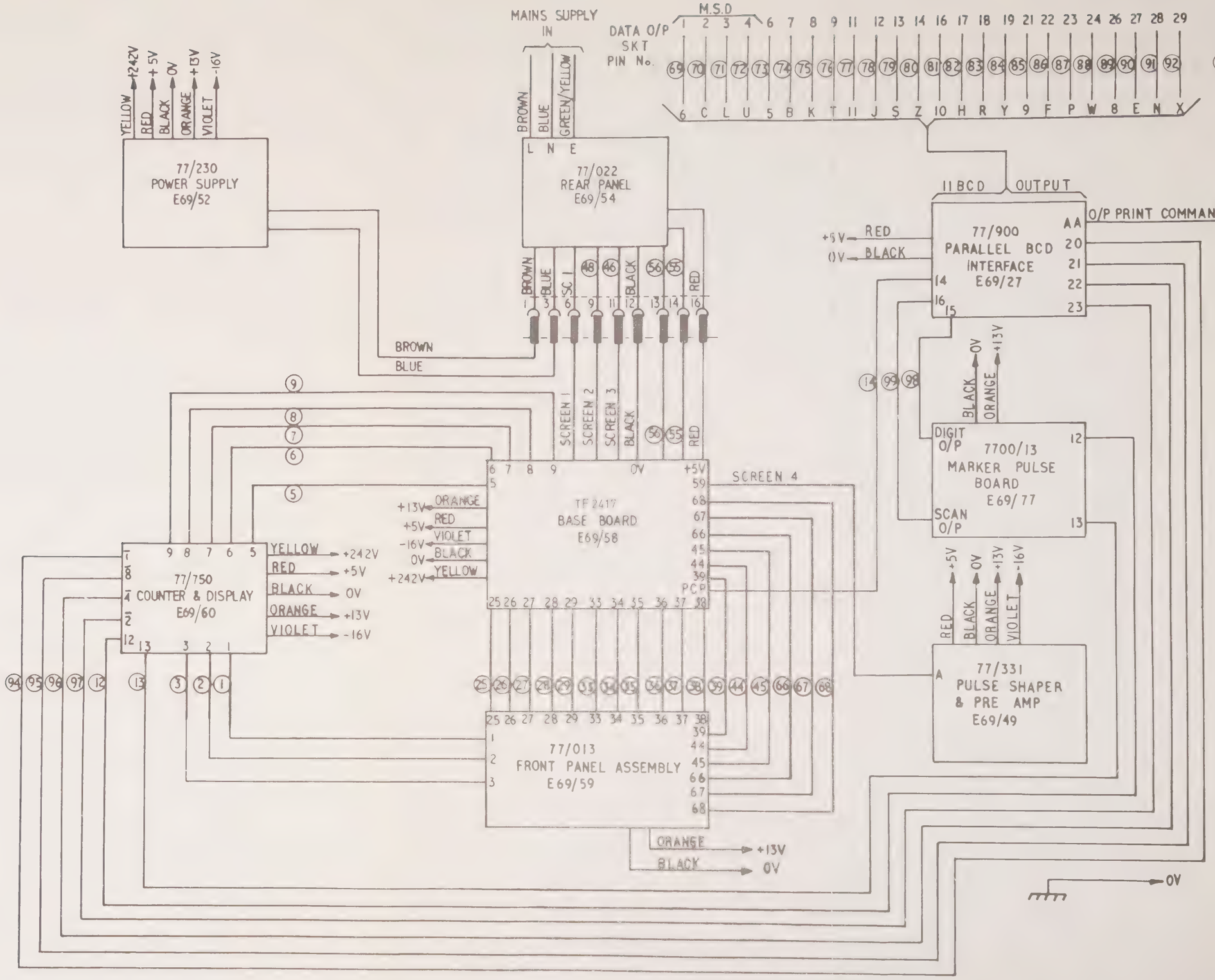
Marconi Instruments Ltd. TF 2417/3

MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2417/3
Drg. No. E70/10


MAINS SUPPLY IN
BROWN
BLUE
GREEN/YELLOW
L N E
77/022
REAR PANEL
E69/54
YELLOW +242V
RED +5V
BLACK 0V
ORANGE +13V
VIOLET -16V
77/230
POWER SUPPLY
E69/52
BROWN
BLUE
SC 1
SCREEN 1
SCREEN 2
SCREEN 3
BLACK
TF 2417
BASE BOARD
E69/58
+13V ORANGE
+5V RED
-16V VIOLET
0V BLACK
+242V YELLOW
+242V YELLOW
+5V RED
0V BLACK
+13V ORANGE
-16V VIOLET
77/750
COUNTER & DISPLAY
E69/60
77/013
FRONT PANEL ASS
E69/59

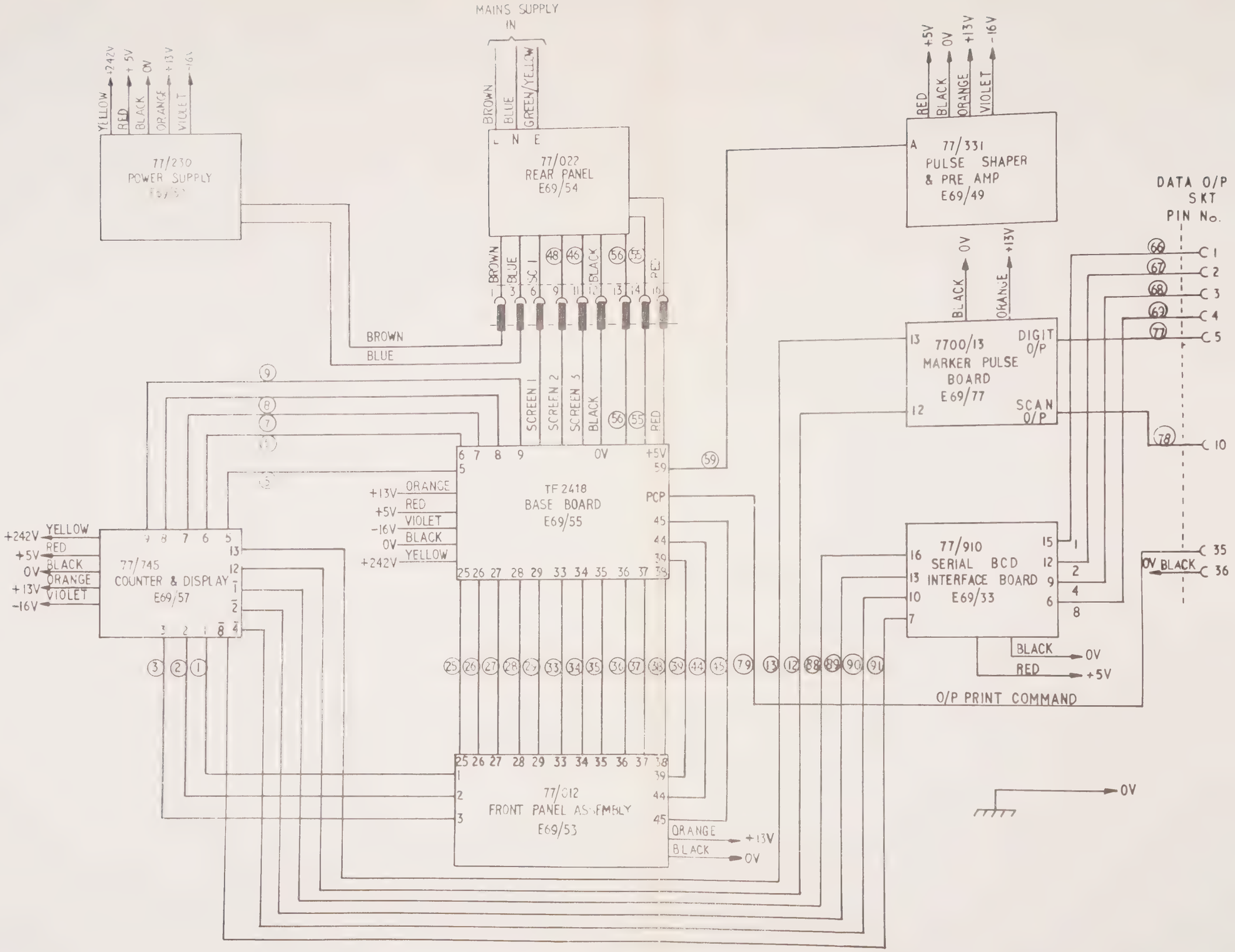


MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2417/3
Drg. No. E70/10



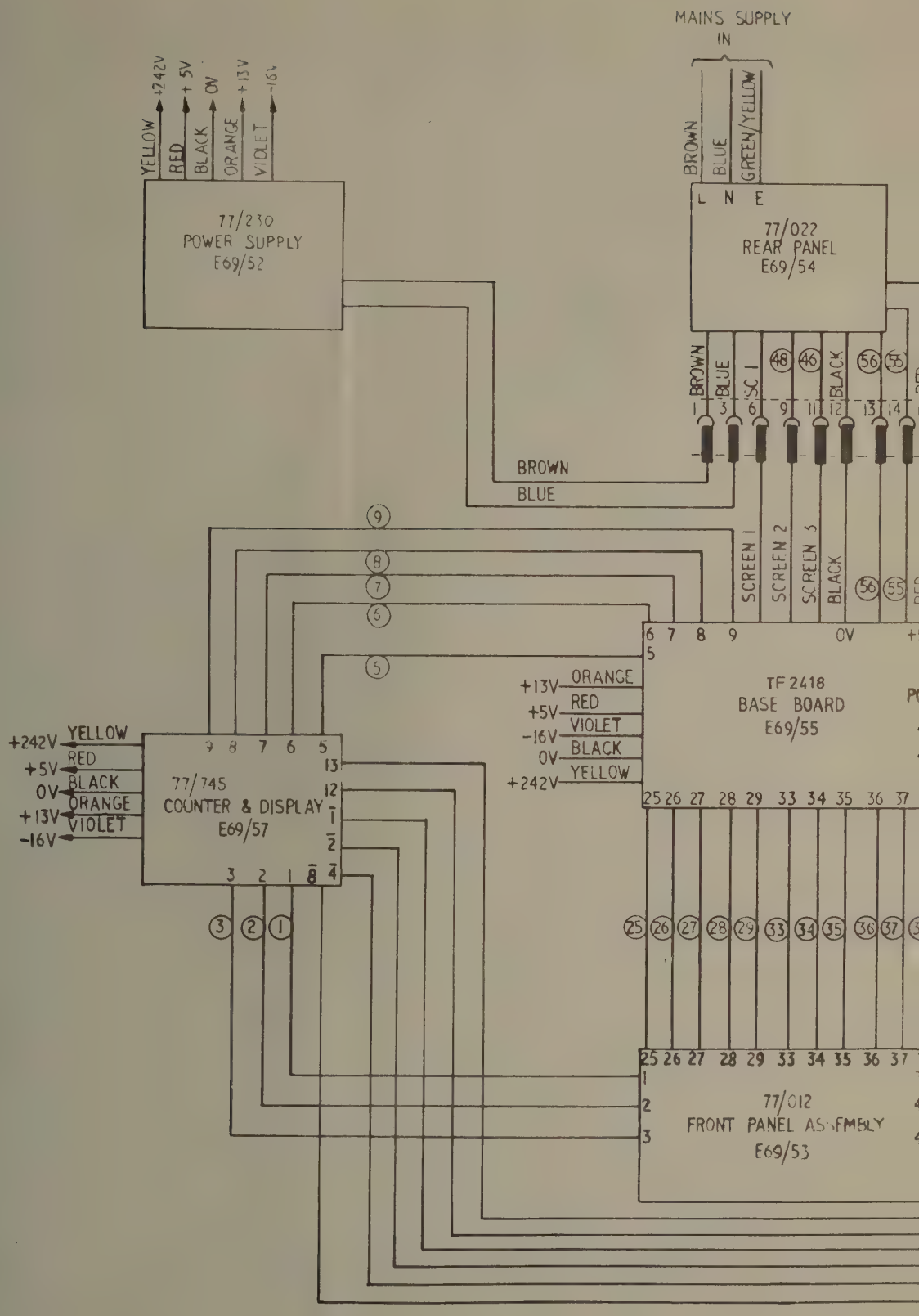
Marconi Instruments Ltd. TF 2417/4

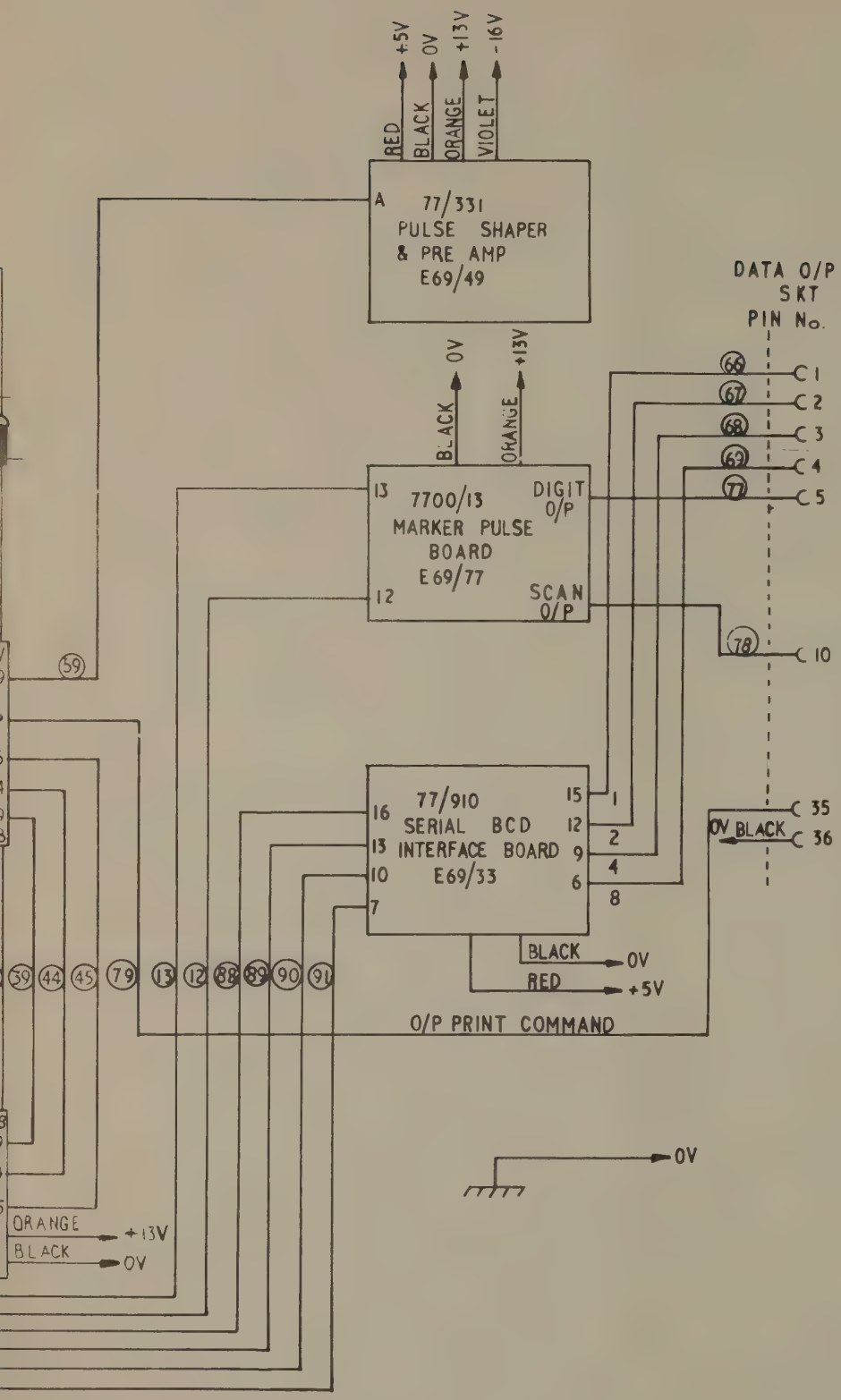
MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2417/4
Drg. No. E70/13



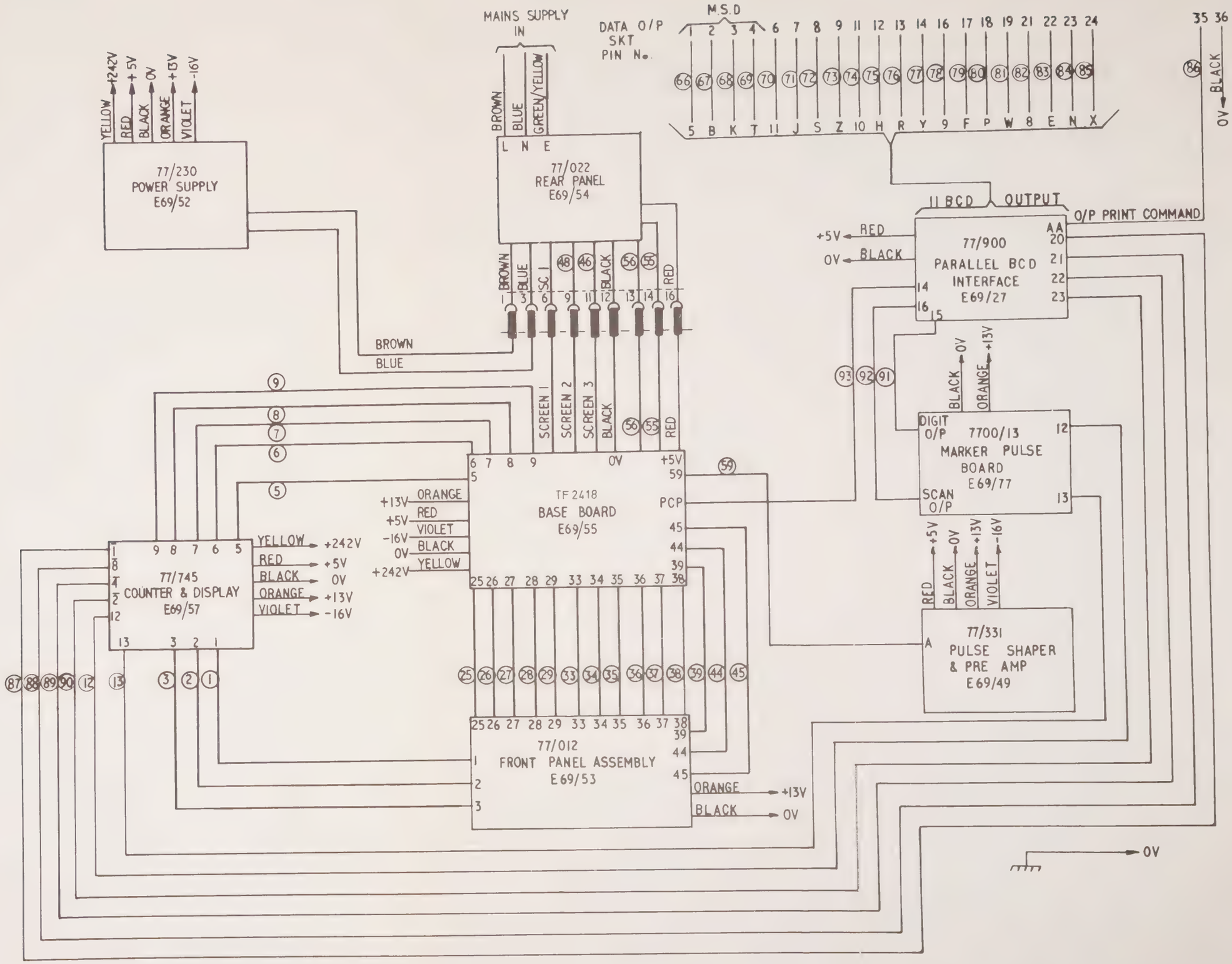
Marconi Instruments Ltd. TF 2418/3

MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2418/3
Drg. No. E70/09

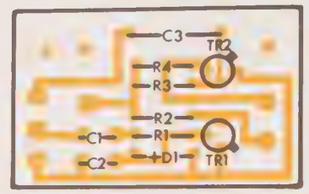

MAINS SUPPLY IN
BROWN
BLUE
GREEN/YELLOW
L N E
77/022
REAR PANEL
E69/54
YELLOW +242V
RED +5V
BLACK 0V
ORANGE +13V
VIOLET -16V
77/230
POWER SUPPLY
E69/52
BROWN
BLUE
SC 1
BLACK
SCREEN 1
SCREEN 2
SCREEN 3
BLACK
0V
TF 2418
BASE BOARD
E69/55
+13V ORANGE
+5V RED
-16V VIOLET
0V BLACK
+242V YELLOW
+242V YELLOW
+5V RED
0V BLACK
+13V ORANGE
-16V VIOLET
77/745
COUNTER & DISPLAY
E69/57
77/012
FRONT PANEL ASSEMBLY
E69/53



MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2418/3
Drg. No. E70/09



MAIN ASSEMBLY
WIRING DIAGRAM
TYPE TF 2418/4
Drg. No. E70/12



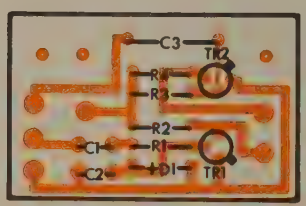
VIEWED FROM NON-COMPONENT SIDE

SCALE 3/4 FULL SIZE.

REF.
M2993

MARKER PULSE BOARD
TYPE 7700/13

BL
7700/13



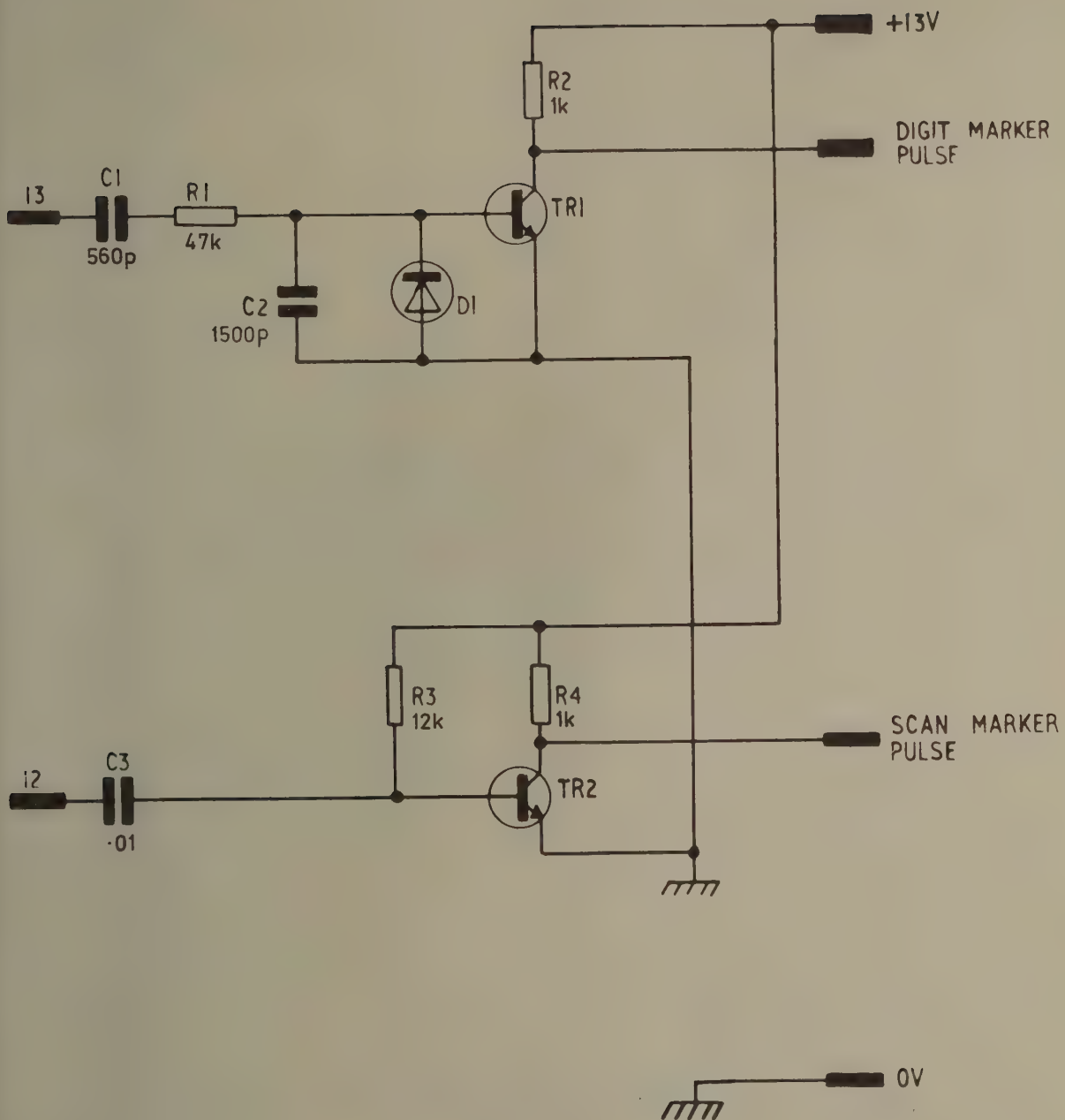
VIEWED FROM NON-COMPONENT SIDE

SCALE 3/4 FULL SIZE.

REF.
M2993

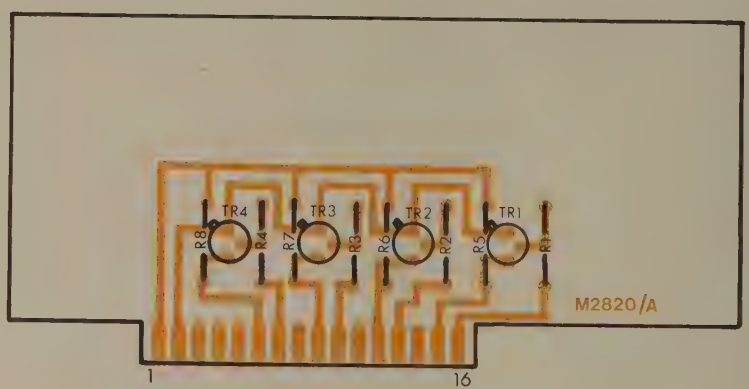
MARKER PULSE BOARD
TYPE 7700/13

BL
7700/13



Marconi Instruments Ltd.
TF 2417/3, TF 2417/4,
TF 2418/3 and TF 2418/4

MARKER PULSE BOARD
CIRCUIT DIAGRAM
TYPE 7700/13
Drg. No. E69/77 ISSUEB



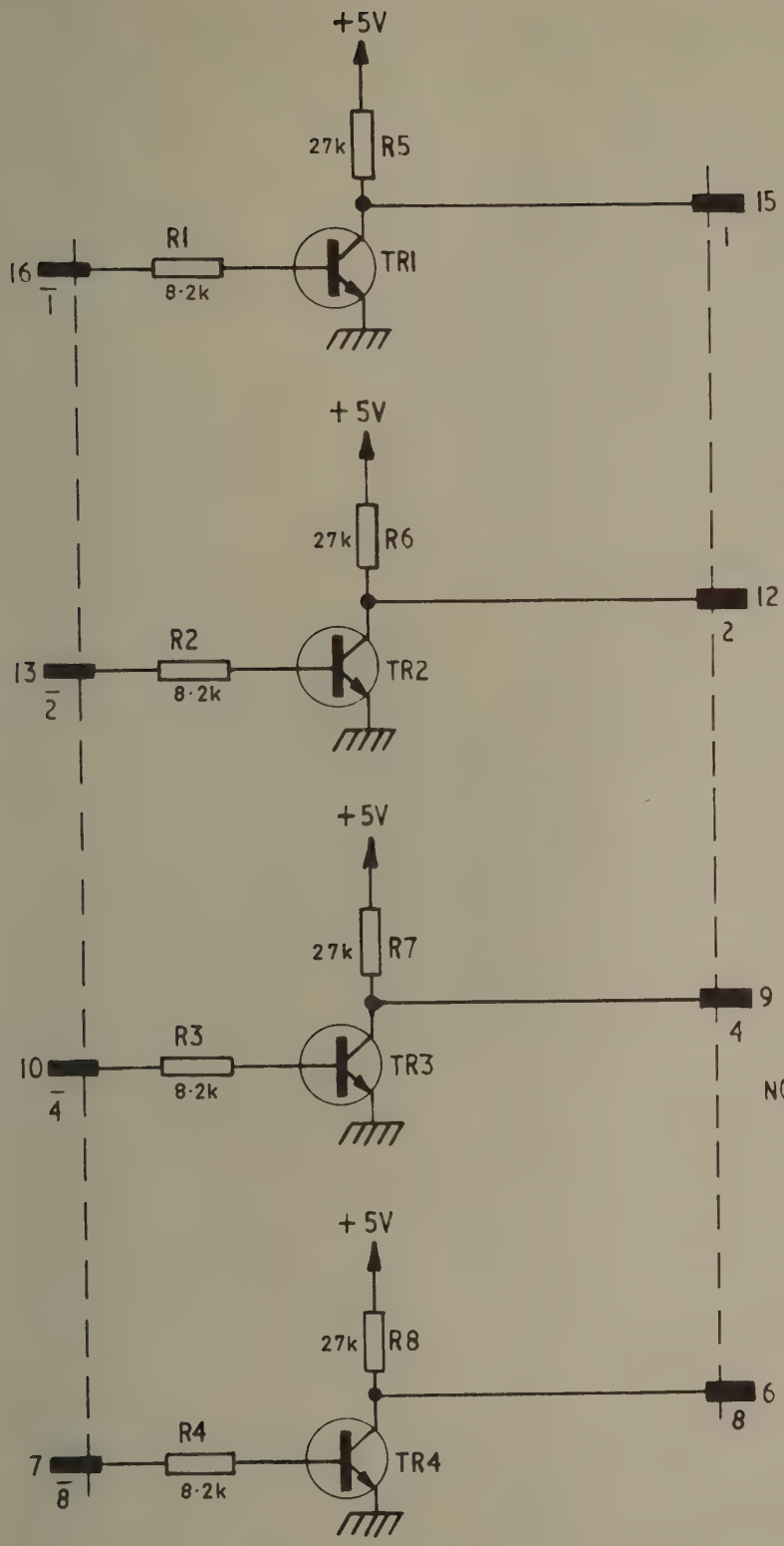
VIEWED FROM NON-COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

REF.
M2820

SERIAL B.C.D. INTERFACE
TYPE 77/910

BL
77/910

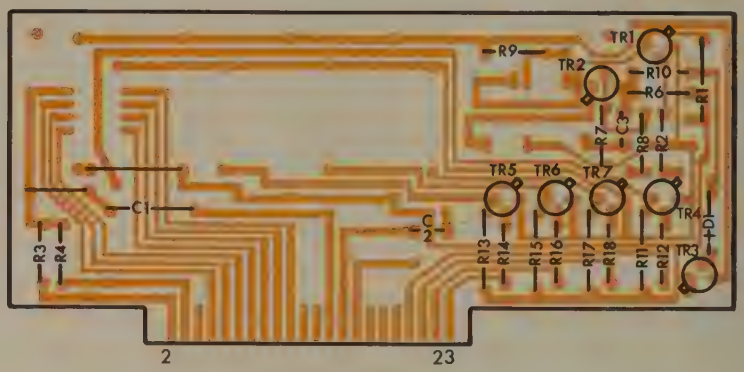


NOTE:- CONNECTIONS THUS:-

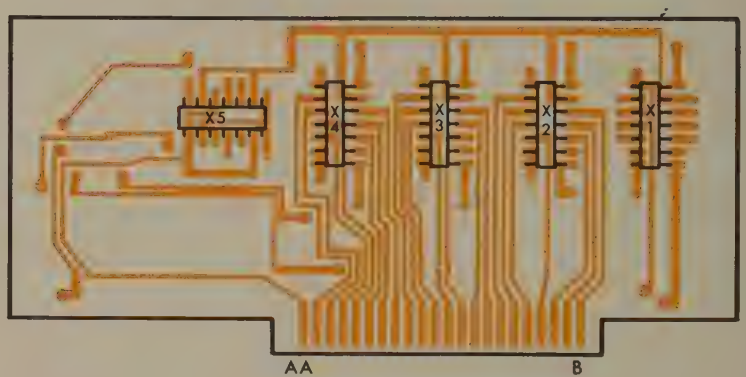
REFER TO EDGE CONNECTOR.

Marconi Instruments Ltd.
TF 2417/3 & TF 2418/3

SERIAL BCD INTERFACE
CIRCUIT DIAGRAM
TYPE 77/910
Drg. No. E69/33



VIEWED FROM NON-COMPONENT SIDE.



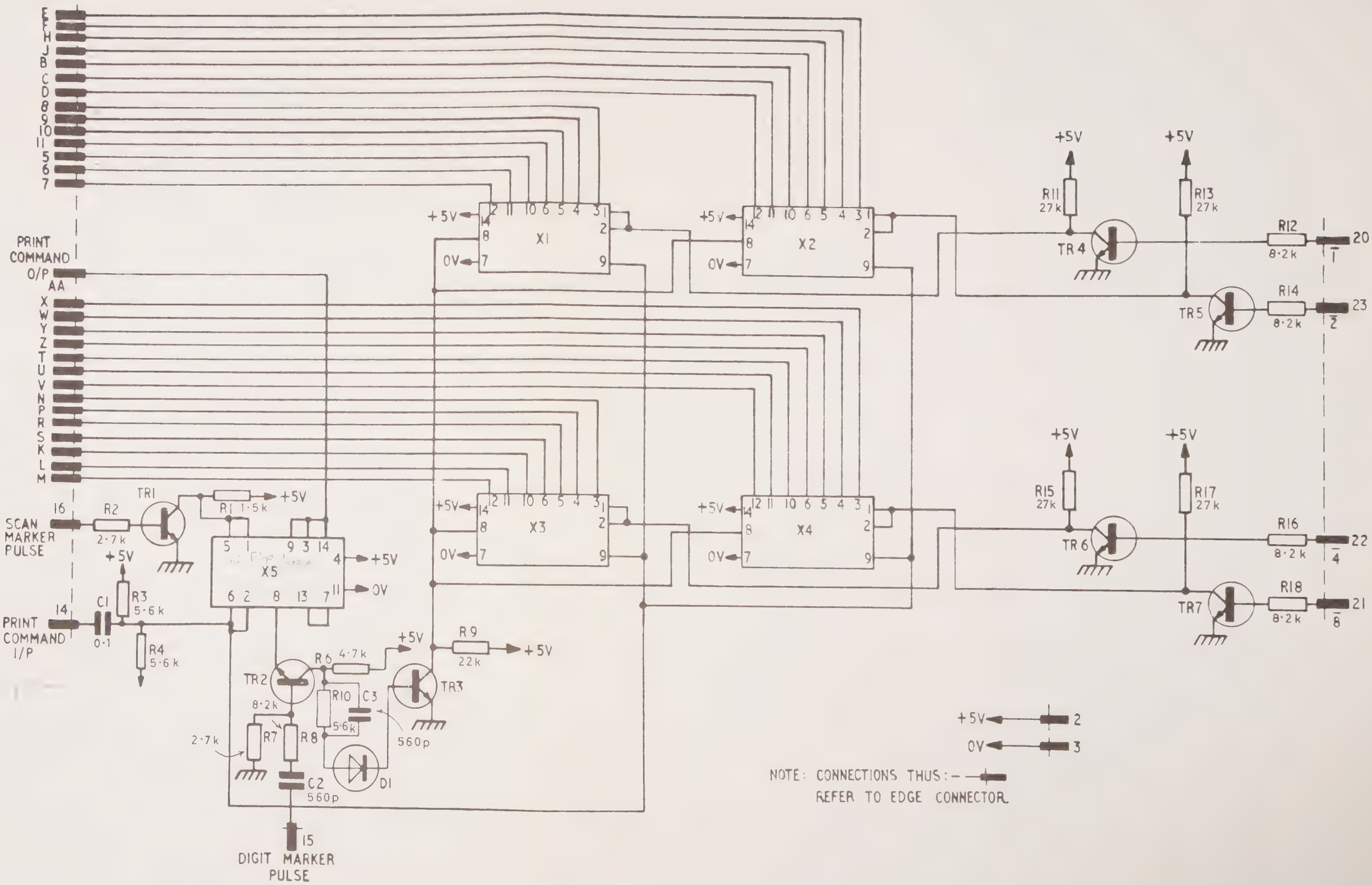
VIEWED FROM COMPONENT SIDE.

SCALE 3/4 FULL SIZE.

REF.
M2778
M2779

PARALLEL B.C.D. INTERFACE
TYPE 77/900

BL
77/900



Marconi Instruments Ltd TF2417 & TF2418 Series

PARALLEL B.C.D. INTERFACE
CIRCUIT DIAGRAM
TYPE 77/900
Drg. No. E69/27 ISSUE A

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